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Date: December 16, 1996

Subject: Recommended Control Levels for the Process Vent, Storage Tank, and Wastewater Planks of the New Source MACT Floor--Pesticide Active Ingredient Manufacturing NESHAP
EPA Contract 68-D-0115; Work Assignment No. 7-155
ESD Project No. 93/59; MRI Project No. 6507-55

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I. Introduction

This memorandum presents recommended control levels for the process vent, storage tank, and wastewater planks of the new source MACT floor for the Pesticide Active Ingredient Production source category. The available information and approach used to develop the recommended levels are also described.

The 1990 Clean Air Act Amendments specify that standards for new sources "shall not be less stringent than the emissions control that is achieved in practice by the best controlled similar source, as determined by the Administrator." This control level is termed the "MACT floor."

Information in responses to a Section 114 information request was used as the starting point in the process to develop the MACT floor. Several of the responses for the best-performing plants reported control efficiencies that were higher than those reported for similar industries in other EPA projects. Therefore, these facilities were contacted for additional information in an effort to verify the reported control levels. Information from the followup contacts was then used along with knowledge about the performance of similar control devices in other industries to develop the recommended control levels for the MACT floor.

The remainder of this memorandum is divided into four sections. Background information from the Section 114 information requests and additional information that was obtained during followup calls with the plants is presented in Section II. A summary of this information, a discussion of factors that

affect control device performance, and conclusions about the validity of the reported control efficiencies are presented in Section III. Recommended control levels for the process vent, storage tank, and wastewater planks of the new source MACT floor are presented in Section IV. References are listed in Section V.

II. Information Obtained From Responses to Section 114 Information Requests and Followup Contacts

In responses to the Section 114 information request, several facilities reported organic HAP and HCl control levels that are higher than those reported for similar industries in other EPA projects. These reported control levels, the types of control devices, and the facility identification numbers are shown in Table 1. As shown in Table 1, the best performing facilities in the industry reported organic HAP control levels above 98 percent for process vents and storage tanks, two facilities reported HCl control levels of 99.97 percent or more for process vents, and one facility reported a control level of 99.99 percent for organic HAP's in wastewater. The facilities reported the organic HAP control levels for many different types of control devices: thermal oxidizers, incinerators that are subject to hazardous waste incinerator regulations under the Resource Conservation and Recovery Act (RCRA), boilers and industrial furnaces that are subject to the Boilers and Industrial Furnaces regulations under RCRA, and scrubbers followed by condensers. (Note: two facilities indicated that all of their wastewater was disposed of by deepwell injection.) The HCl control devices were water and caustic scrubbers.

For process vents, two control levels are shown for each process in Table 1. The first control level is the estimated overall control level for the process; it was calculated from the reported data for all of the individual process vent streams related to that process. The second control level is the reported control level for the primary control device. For several of the processes, these two control levels do not match because some process vents are not controlled or are controlled by a separate, less efficient control device. The highest verified overall process control level is the value that would be used as the basis for the new source MACT floor control level.

For wastewater, the standard will be applied on an individual stream basis rather than an overall process basis. Therefore, only the control level for the most efficient control device needs to be identified in Table 1. In this case, both are shown simply because the most efficient control device also happens to be used to control all wastewater streams at the facility, and the same control level was reported for each stream.

TABLE 1. CONTROL DEVICES AND ESTIMATED OVERALL CONTROL EFFICIENCIES FOR PROCESS VENTS, STORAGE TANKS, AND WASTEWATER SYSTEMS.

Plant	Estimated overall control efficiency for each process, percent	Process	Primary control device	Reported efficiency of primary control device, percent
Organic HAP emissions from process vents				
9	99.99	25	Boiler[a]	99.99
22	99.99	74	Thermal oxidizer	99.99
	99.99	75	Thermal oxidizer	99.99
	99.99	76	Thermal oxidizer	99.99
	99.99	77	Thermal oxidizer	99.99
	99.99	78	Thermal oxidizer	99.99
	99.99	79	Thermal oxidizer	99.99
	99.9	80	Thermal oxidizer	99.99
	99.9	81	Thermal oxidizer	99.99
	99.99	82	Thermal oxidizer	99.99
	99.99	83	Thermal oxidizer	99.99
	99.99	84	Thermal oxidizer	99.99
	99.99	85	Thermal oxidizer	99.99
	99.99	86	Thermal oxidizer	99.99
20	99.0	66	Absorber/condenser	99.6
17	99.5	61	Industrial furnace	99.5
	99.2	63	Industrial furnace	99.5
12	99.99	37	Boiler	99.99
	99.9	38	Boiler	99.99
	99.0	39	RCRA incinerator	99.99
HCl emissions from process vents				
11	100.0	31	Water scrubber	100.0
		32	Water scrubber	100.0
		33	Water scrubber	100.0
9	99.97	24	Acid scrubber	99.95
		25	Acid absorber/caustic scrubber in series (two backup caustic scrubbers, 99.99% and 95%)	99.9997
12	99.75	40	2 caustic scrubbers in series	99.75

Plant	Estimated overall control efficiency for each process, percent	Process	Primary control device	Reported efficiency of primary control device, percent
Wastewater				
11	99.99		RCRA incinerator	99.99

[a]In the response to the Section 114 information request, this control device was identified as a thermal oxidizer. In the followup telephone conversation, it was identified as a boiler.

Each of the facilities in Table 1 was contacted for additional information to determine the validity of the reported control efficiencies. Specifically, they were asked to describe the methodology used to develop the reported efficiencies, including whether they had conducted emissions tests, whether the emission streams are routed to the control device continuously, and whether the control device is achieving the reported efficiency continuously.

The information obtained in the responses to the Section 114 information request and in followup calls for each of the plants in Table 1 is described in the subsections below. Organic HAP and HCl control levels for process vents are described in Sections B and C, respectively. Storage tank control levels are described in Section D, and wastewater control levels are described in Section E. Because many of the facilities were using incinerators or boilers that are subject to hazardous waste incineration regulations under RCRA, a review of some of the hazardous waste incineration requirements is presented in Section A.

A. Hazardous Waste Incineration Regulations

All incinerators, boilers, and industrial furnaces that burn hazardous waste must demonstrate a specified 99.99 percent or greater destruction and removal efficiency (DRE) on the organic compounds in the hazardous waste feed. This is accomplished by conducting a trial burn, during which a synthesized waste or waste spiked with principal organic hazardous constituents (POHC's) (typically liquid, but it can also include gas) of known composition and flow is fed to the unit. The material must contain one or more POHC's. The POHC's are selected on a case-by-case basis from a list in an EPA guidance document for permit writers; typically, the selected POHC's are either major components in the hazardous waste that the facility wants to burn or they are compounds that are more difficult to destroy than the major compounds in the hazardous waste. In most cases, the trial burn must show a DRE of 99.99 percent. Then, as long as the facility operates within permit conditions (which are established based on operating conditions during the trial burn), the unit is assumed to be achieving the 99.99 percent DRE on all hazardous waste.

A second component of the hazardous waste incinerator regulations is that either carbon monoxide (CO) or hydrocarbon (HC) concentrations in the outlet stream be monitored continuously to ensure that the unit operates at high combustion efficiency and, thus, minimizes the production and emissions of products of incomplete combustion (PIC's). The PIC's consist of thermal decomposition products, compounds that are synthesized during or immediately after combustion, and any unburned organic compounds from the waste feed. The PIC emissions are minimized when the units operate under good operating conditions. To

ensure that boilers and industrial furnaces operate at high combustion efficiencies, the regulations require either a CO limit of 100 ppmv or a HC limit of 20 ppmv, both corrected to 7 percent oxygen. These same requirements are also included in permits for incinerators.

B. Organic HAP Control Levels for Process Vents

Plant 9.[1,2,3] In its response to the Section 114 information request, this facility indicated that all process vents from process 25 are routed to a thermal oxidizer, and the reported control efficiency of the thermal oxidizer was 99.99 percent. Thus, the overall process vent control efficiency for this process was also reported to be 99.99 percent.

In followup conversations, the thermal oxidizer was identified as a boiler. The facility indicated that process vent emissions are not routed to the boiler continuously; the incinerator is down for maintenance for a certain period of time each year. Organic process vent emissions are routed to a process recovery device while the incinerator is down. The recovery rate of this recovery device has not been provided, however, even if the organics in this stream were not recovered or controlled, the control efficiency for this process would still be greater than 99 percent. A trial burn with a mixed (liquid and gas) POHC was performed to demonstrate the DRE. This test demonstrated that the boiler achieves a DRE of 99.99 percent. The average feed rate of POHC to the incinerator during the trial burn was approximately 618 pounds per hour with approximately 376 standard cubic feet per minute stack flow rate. The average inlet concentration during the trial burn was 228,000 ppmv corrected to 7 percent O_2 by volume. The average feed rate to the incinerator from this process during regular operation is approximately 11.9 pounds per hour at 2 standard cubic feet per minute flowrate. The average concentration in the exit stream from this process during normal/regular process operation is 233,500 ppmv organic HAP; process 25 is a small percentage of the load to the oxidizer during regular process operation (less than 5 percent). The concentration to the thermal oxidizer during normal operation is unknown. In addition to the trial burn, a source test was performed on process vent emissions; however, only the exit stream from the thermal oxidizer was measured. The facility has not performed an emissions test on the inlet and outlet streams to demonstrate the control efficiency for process vent emissions. This facility monitors the CO concentration to comply with the 100 ppmv limit.

Plant 22.[4] The Section 114 response indicated that nearly all process vent emissions are routed to a thermal oxidizer that has a reported control efficiency of 99.99 percent. The remaining process vents are routed to a carbon adsorber with a reported control efficiency of 99 percent. As shown in Table 1,

the overall control efficiency for processes 74 through 86 is 99.9 percent or greater.

In followup, the plant representative indicated that no liquid waste is burned at the facility; the thermal oxidizer controls vapor emissions only. The facility has performed a stack test on the exit stream from the thermal oxidizer. The facility has not performed an emissions test on the inlet and outlet streams to demonstrate the control efficiency of the device. Based on the design of the oxidizer and on the exit stream stack test, Plant 22 assumed in its response that the device achieves 99.99 percent efficiency. Processes are vented to the thermal oxidizer continuously, i.e., 100% of the time. The facility monitors temperature to demonstrate good operation of the thermal oxidizer. A copy of the exit stream emission test report may be requested from the corporate representative.

Plant 17.[5] The Section 114 response indicated that nearly all process vent emissions are routed to an industrial furnace that has a reported control efficiency of 99.5 percent. The remaining process vents are either uncontrolled or routed to a scrubber with a reported control efficiency of 90 percent. Therefore, the overall process vent control efficiency for each of two processes was calculated to be 99.5 and 99.2 percent.

In followup, the plant representative indicated that the control device burns both liquid and vapor streams. The facility has performed a RCRA Part B pre-Trial Burn on the industrial furnace to demonstrate liquid waste destruction. The plant has not performed emissions testing on the process vent emission streams. (No test data was available for this facility.)

Plant 20.[6] Based on the response to the Section 114 information request, this plant vents most process vents to an absorber and condenser in series. This control equipment reportedly reduces acetonitrile emissions by 99.6 percent. Other process vents are uncontrolled. Therefore, the overall process vent control efficiency for process 66 was estimated to be 99.0 percent.

The plant representative indicated in followup that an emissions test to demonstrate the control efficiency of the device has not been performed. The control efficiency reported in the response was based on the design of the control devices.

Plant 12.[7,8,9,10] Based on data from the Section 114 response, some process vent streams are routed to boilers, some are routed to a RCRA incinerator, and others are uncontrolled. Control efficiencies were reported to be 99.99 percent for both the boilers and the RCRA incinerator. Estimates for the overall process vent control efficiency for three processes at the plant ranged from 99.0 to 99.99 percent.

In followup, the plant representative indicated that there are two boilers at the facility. These were originally vapor stream incinerators and were later modified to be boilers; while the boilers were once used for liquid waste stream destruction, they are no longer used for liquid waste streams because regulatory requirements are too expensive. The facility has not performed a formal Trial Burn. The plant representative indicated that the facility has performed a "stack test" on the boiler to demonstrate 99.99 percent reduction for liquid streams. An emissions test for vapor streams has not been done. However, in the Section 114 response, the plant representative assumed that the boiler was achieving 99.99 percent for process vent emission streams. All emissions streams from processes 37 and 38 are vented continuously to a boiler; one of the two boilers is always on-line, and the processes are not operated unless it is venting to a boiler.

The RCRA incinerator burns both liquid hazardous waste and vapor streams. The plant has performed a Trial Burn to demonstrate 99.99 percent DRE for liquid wastes. The plant has not performed an emissions test to demonstrate the efficiency achieved by the incinerator on vapor streams. The plant representative assumed that the control efficiency for process vent emissions is equal to the DRE for liquid wastes. The plant is required to keep data on the operating temperature and residence time of the incinerator. Process vent emissions are routed to the incinerator continuously; if the incinerator is shutdown, then the process is shutdown as well. During the trial burn, approximately 380 pounds per hour of POHC was fed to the incinerator at an average flow rate of 8,200 standard cubic feet per minute (concentration averaged 1,590 ppmv organic HAP, no data on percent O_2). For regular process operation, approximately 37.5 pounds per hour of organic HAP is routed to the incinerator from process 39 at 246 standard cubic feet per minute inlet flow rate (concentration is approximately 16,100 ppmv). At least one other PAI process at the plant also vents to this device.

C. HCl Control Levels for Process Vents

Plant 11.[11] In its response to the Section 114 information request, this plant indicated that HCl was emitted from two processes. These HCl emissions were controlled using water scrubbers (in series with RCRA incinerators that are used to control organic HAP emissions) with reported control efficiencies of 100 percent. In a followup conversation, the corporate representative indicated that the reported control efficiency was incorrect. The scrubbers were designed to achieve a 99 percent reduction. Tests have not been conducted to determine the actual control efficiency.

Plant 9.[1,2,3] In its response to the Section 114 information request, this plant indicated that HCl was emitted from two processes.

The plant indicated that all HCl emissions from process 24 are controlled by a two-stage acid absorber reportedly achieving 99.95 percent. The facility has not performed an emissions test on the device to demonstrate the control efficiency for HCl. The control efficiency reported in the response is based on design of the devices.

For process 25, the overall control efficiency was estimated to be 99.9996 percent. For this process, the HCl emission stream is controlled by an acid absorber and caustic scrubber in series (these devices are associated with the thermal oxidizer). When the thermal oxidizer is down, the HCl in this stream is controlled by one of two backup scrubbers. The absorber and scrubber associated with the thermal oxidizer reportedly achieve an overall 99.9997 percent reduction in HCl emissions. One of the backup scrubbers reportedly achieves 95 percent control efficiency for HCl and the other backup scrubber was reported to achieve 99.99 percent control efficiency for HCl. The facility has not performed emission tests on these control devices to determine the HCl control efficiency. The control efficiencies reported in the response are based on design of the device.

Plant 12.[7,8,9,10] From the response to the Section 114 information request, it is estimated that the HCl control efficiency for process 40 is 99.75 percent. The HCl emissions were controlled using two caustic scrubbers in series with reported control efficiencies of 95 percent each. In a followup conversation, the plant representative indicated that the first scrubber is an HCl control device with a design efficiency of 95 percent. The outlet stream from the first scrubber is routed to a second scrubber that is a general building air wash system (high inlet gas flowrate). This device is used to controls vapors collected from miscellaneous sources such as sample hoods and is intended to be an industrial hygiene device rather than an air pollution control device. The control efficiencies provided by the facility for each of these devices is based on design. Tests have not been conducted to determine the actual HCl control efficiency.

D. Storage tanks

Several facilities vent storage tank emissions to control devices with efficiencies that were reported to be greater than 98 percent. Five facilities reported 22 storage tanks that are controlled above 98 percent; 21 out of 22 of the tanks are controlled with combustion technology.[12] These facilities use the same control device units to control storage tank emissions that are used to control process vent emissions (i.e., the

control devices are not dedicated to storage tank emissions).[1,2,3,4,7,8,9,10,13] As is the case for process vent emissions, the facilities have not performed emission tests to demonstrate the reduction efficiency achieved by the devices for storage tank emission streams.

E. Wastewater

Plant 11.[11,13] In its response to the Section 114 information request, this facility indicated that all wastewater streams are incinerated in any of several RCRA incinerators. For organic compounds in all wastewater streams, the control efficiencies of all incinerators were reported to be 99.99 percent. The RCRA incinerators are used to control emissions from some process vents and storage tanks as well as to incinerate wastewater and hazardous waste.

In followup conversations, plant and corporate contacts indicated that the facility conducted a Trial Burn, which demonstrated a 99.99 percent DRE. The POHC incinerated during the Trial Burn was chosen based on compounds in liquid waste streams and in wastewater streams. The DRE would apply to wastewater streams that are burned in the RCRA incinerators just like it would to any other liquid waste stream at the facility (however, more auxiliary fuel would be needed to evaporate all the water and maintain the required operating temperature). The facility has not conducted a test to determine the control efficiency on organics in wastewater alone. (Monitoring procedures were not discussed during the conversations.)

III. Discussion

A. Organic HAP control efficiency

To reduce organic HAP emissions from process vents, four of the five plants listed in Table 1 for process vents used combustion control devices and one used a scrubber followed by a condenser. The combustion devices were used to control a variety of organic HAP's; the other devices were used to control only a single organic HAP.

According to the follow-up contacts, none of the five plants have conducted emissions tests to determine the emissions reductions for process vent emissions alone. The four plants that used combustion devices reported control efficiencies that were based on (1) DRE's from trial burns, (2) destruction efficiencies for liquid wastes from non-trial burn tests, and (3) design specifications. The plant that used an absorber and condenser in series reported a design control efficiency.

None of the reported control efficiencies should be used as the control efficiency for the new source MACT floor. The DRE's from trial burns indicate the percentage reduction in organic

compounds in liquid (or mixed) wastes, but no data are available to show that they represent the control efficiency that would be achieved on a gas stream alone. In addition to no data on the control efficiency for gas streams alone, there also are no data to verify the control efficiencies that were calculated based on design specifications. The validity of the reported assumed control efficiency for process vents alone is suspect. According to the available test data (source test at Plant 9 and Trial Burn at Plant 12) and the Section 114 responses, the operating conditions during the performance test may not necessarily be similar to the conditions during normal process operation. Two important differences include: (1) the amount of organic HAP emission from processes during normal operation may be a fraction of the POHC feed to the combustion device during the performance test, and (2) during normal continuous and batch process operation, the amount of organic HAP emissions in the process vent streams may vary significantly throughout the batch or process cycle. Such differences in concentration may lead to differences in DRE (or control efficiency), as described in a report summarizing the results of Trial Burns.[14] Given these potential differences, the reported control efficiencies based on DRE's should not be the basis of the process vent new source MACT floor for organic HAP.

To reduce organic HAP emissions from storage tanks, all but one of the best controlled storage tanks used combustion-based control devices. The same devices that are used to control emissions from process vents are used to control emissions from storage tanks. As described above, the reported control efficiencies for these devices can not be supported with test data. In addition, there is no data to demonstrate the efficiencies for dedicated control devices for storage tanks. The MACT standard for storage tanks will address the control efficiency achieved on storage tanks alone. Thus, the reported control efficiencies should not be used as the basis for the new source MACT floor.

Variations in chamber temperature, residence time, inlet concentration of organics, compound type, and mixing affect the organics destruction efficiency of a thermal incinerator. Performance tests demonstrate that all new thermal incinerators can achieve at least 98 percent VOC destruction (or HAP destruction, since most HAP's are VOC's) for vent streams with VOC concentrations above 2,000 ppmv at combustion chamber temperatures ranging from 1,300 to 2,370°F and residence times of 0.5 to 1.5 sec. For VOC streams with concentrations below 2,000 ppmv (corresponding to 1,000 ppmv VOC in the incinerator inlet stream because air dilution is typically 1:1), all new thermal incinerators can achieve either a reduction of 98 percent or greater or an outlet VOC concentrations of 20 ppmv or lower (i.e., for a low inlet concentration, 98 percent may not be possible, but the outlet concentration would not exceed 20 ppmv).[15] A flare that is designed and operated in accordance

with the requirements in 40 CFR 63.11 also achieves at least 98 percent reductions.

The control efficiencies achieved with condensers and scrubbers vary depending on stream characteristics. Condensers are most efficient on streams with high concentrations and low volatility. Scrubber efficiency depends on finding a solvent in which the HAP is highly soluble; the absorptive capacity and strippability of the solvent are other important factors. Although each of these control devices may be able to achieve an efficiency equal to or greater than a combustion device for certain streams, none can do it as consistently across the board as a combustion device.

B. HCl control efficiency

Design of HCl control devices for three processes at two facilities indicate control efficiencies that are greater than 99 percent. As indicated in the follow-up contacts, neither of these facilities have conducted emissions tests to determine the HCl control efficiencies for these devices. The control efficiencies reported were based on design parameters of the devices.

The HCl emissions in the PAI industry may occur from two types of operations: (1) HCl generated during process operation and vented from the process, or (2) HCl generated from control of chlorinated organics by combustion. Variability in the inlet gas HCl concentration, the inlet gas flow rate and the water flow rate (liquid to gas ratio), the concentration of HCl in the scrubber water, and the water temperature affect absorption of HCl into water in a packed bed scrubber.

The best reported HCl controls are scrubbers for two processes at Plant 9, i.e., 99.9996 and 99.95 percent. Although no test data are available to show the HCl control efficiencies for scrubbers at these PAI plants, tests of similar scrubbers used to control HCl emissions from hazardous waste incinerators are available. These tests indicate that HCl removal efficiencies for packed bed scrubbers following incineration devices of 99.90 and 99.94 percent can be achieved.[14] These plants in the hazardous incineration study with control efficiencies of 99.9 percent or higher are controlling HCl with two or three scrubbers in series. The HCl control devices used for one process at Plant 9 follow an incinerator and have a similar application to those devices tested in the hazardous waste incineration study. At least one State, Texas requires 99.9 percent reduction of HCl emissions generated from the combustion of chlorinated organics in hazardous waste incinerators.

C. Wastewater control efficiency

Plant 11 reported its incinerators have control efficiencies of 99.99 percent on hazardous waste, but no wastewater-specific control efficiency data are available. However, it is reasonable to assume that, because the devices are RCRA incinerators, the control efficiency is at least 99 percent, the same level achievable by steam stripping for many compounds. Data are not available to the EPA to conclude that the incinerator is achieving greater efficiency.

IV. Recommended MACT Floor Control Levels

Based on the information obtained through the follow-up contacts, the new source MACT floor for organic HAP emissions from process vents and storage tanks should be based on combustion technology. The control efficiency, however, should be 98 percent, a level that has been demonstrated in numerous tests. The floor should not be based on the higher efficiencies reported by the facilities in the Section 114 responses because none of the facilities had data to support a control efficiency greater than 98 percent. Other types of control devices may be able to achieve control efficiencies equal to or greater than 98 percent on certain streams, but because there is significant variability in stream characteristics throughout the industry, not all streams can be controlled to the same high levels as could be achieved for a specific individual stream.

Based on the follow-up contacts, the new source MACT floor for HCl emissions should be based on a 99.9 percent control efficiency. The floor should not be based on a higher efficiency reported in the responses to the Section 114 information collection request because none of the facilities had test data to support their reported design control efficiency. While no test data was provided for the PAI industry, test data from similar scrubbers in another industry show that the HCl control efficiency of 99.9 percent is achievable. Without specific test data for this industry, the HCl control efficiency that has been demonstrated in other industries will be used.

Based on information from Plant 11, the control level for the wastewater systems plank of the new source MACT floor should be 99 percent. This plant has not conducted a test showing the control efficiency for the incinerator when burning only wastewater.

V. References

1. Confidential business information.

2. Confidential business information.

3. Confidential business information.

4. Confidential business information.

5. Confidential business information.

6. Confidential business information.

7. Confidential business information.

8. Confidential business information.

9. Confidential business information.

10. Confidential business information.

11. Confidential business information.

12. Confidential business information.

13. Confidential business information.

14. Performance Evaluation of Full-Scale Hazardous Waste Incinerators. Volume 2 Incinerator Performance Results and Volume IV Appendices C through J. Midwest Research Institute. November 1984.

15. Memorandum and attachments from Farmer, J., EPA/ESD, to Ajax, B. et al. August 22, 1980. Thermal incinerators and flares.

Docket No. A-95-20

Category II-B

The following information is located in the confidential files of the Director, Emission Standards Division, Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711. This information is confidential pending final determination by the Administrator and is not available for public inspection.

Attachment to Recommended Control Levels for the Process Vent, Storage Tank, and Wastewater Planks of the New Source MACT Floor Memorandum (part of docket item II-B-21).

This attachment consists of the full citations for the confidential references in this memorandum.

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Date: January 6, 1997

Subject: Growth Projections for the Pesticide Active Ingredient Production Industry--Pesticide Active Ingredient Manufacturing NESHAP
EPA Contract 68D60012; Task Order No. 0004
ESD Project No. 93/59; MRI Project No. 4800-04

From: Karen L. Schmidtke KS

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I. Introduction

This memorandum presents the available information and the approach used to estimate the growth of the Pesticide Active Ingredient (PAI) Production industry in the five years after promulgation of the standards. The EPA is required to estimate the impacts of the MACT standards. The number of new sources expected for this industry in the five years following promulgation will be used in the determination of impacts of the new source MACT.

II. Estimation of the Number of New Affected Sources

The number of new affected sources was estimated using the number of existing affected sources and the industry growth rate in the five years following promulgation of the standards. The total number of existing affected sources is estimated to be 78 sources.[1] From 1983 to 1993, the amount of PAI production increased from 975 million pounds to 1,150 million pounds at an approximate average of 2 percent per year.[2] The projected growth rate has been based on 10 years of production data for the industry. Looking at shorter time periods of 2 to 3 years within the 1983 to 1993 decade indicates alternating periods of increasing and declining production. Because there is fluctuation in PAI production from year to year, basing the growth projection on a longer period of time is likely to provide a more representative indication of industry trends.

Because there was no available information on the increase in the number of sources over time, the annual average 2 percent increase in PAI production was assumed to be equivalent to the increase in the number of new sources. It was assumed that the industry will grow at the same rate in the five years following

promulgation. Applying this growth rate to the 78 existing affected sources results in an estimated 8 new sources over the five years following promulgation of the NESHAP [$78 \times ((1 + 0.02)^5 - 1) = 8$].

III. References

1. Memorandum from K. Schmidtke, MRI, to L. Banker, EPA:ESD. November 27, 1996. Estimation of the Number of Affected Sources in the Production of Pesticide Active Ingredient Source Category.

2. Chemical and Engineering News. July 26, 1995.

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Date: April 15, 1997

Subject: Summary of Data from Responses to Information Collection Requests and Site Visits for the Production of Pesticide Active Ingredients NESHAP
EPA Contract No. 68-D1-0115; Work Assignment No. I-04
ESD Project No. 93/59; MRI Project No. 4800-04

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I. Introduction

This memorandum summarizes the data that were provided by the pesticide active ingredient (PAI) production industry in response to Section 114 information requests that were sent to nine companies. The data were collected for use in developing maximum achievable control technology (MACT) for national emissions standards for hazardous air pollutants (NESHAP) for the production of PAI industry. The companies that received information requests were selected because they have at least one plant that: (1) is a major source, (2) produces a variety of products, (3) uses a variety of production processes, and (4) implements air pollution control technology. Companies with more than one plant meeting these criteria were favored over companies with only one plant. Information was also obtained from a site visit at one plant belonging to another company.

Data were obtained from 23 plants.[1] Two of the plants were area sources, and information from one plant is incomplete. Therefore, data from 20 plants are summarized in this memorandum. This memorandum also describes procedures used to estimate total annual uncontrolled and controlled emissions from PAI processes at the 20 plants. The remainder of this memorandum is divided into five sections that each address one of the five types of emission points in the PAI production industry: process vents, equipment leaks, storage tanks, wastewater systems, and bag dumps and product dryers.

II. Process Vents

The 20 plants reported a total of 93 processes that, collectively, emit 39 hazardous air pollutants (HAP). A list of the HAP is presented in Table 1. Hydrochloric acid (HCl) is used by the most plants, is emitted from the most processes, and is the HAP that is emitted in the greatest quantity. Methanol and toluene, which are used by 10 and 7 plants, respectively, are the most widely emitted organic HAP. Of all of the organic HAP, toluene is emitted in the greatest quantity (controlled basis). The next highest emissions are for methanol. Chlorine, HCl, hydrogen cyanide, and hydrazine are inorganic HAP; the other HAP are all volatile organic compounds (VOC).

Table 2 presents operating and emissions data for each of the 93 processes. Active ingredients and intermediates are manufactured in 77 and 15 of the processes, respectively; 1 process was not identified. Sixty-six of the processes are batch processes, 19 are continuous, and 8 are a combination of batch and continuous operations.

Operating hours for the 93 processes ranged from 96 to 8,760 hr/yr for batch processes and from 336 to 8,136 hr/yr for continuous processes. Data on process operating hours were provided in as many as three formats by each facility: (1) the hours per batch and batches per year for batch processes, (2) the hours per day and days per year for continuous processes and some batch processes, and (3) the operating hours per year for the individual process vents. When data were provided in multiple formats, the resulting hours per year often varied. Therefore, the following criteria were used to select the process operating hours that are presented in Table 2:

1. If the facility provided only one value, it was automatically selected;
2. Hours per year for individual process vents were not selected unless it was the only value available; individual process vent hours per year may differ from the process operating hours if the unit operation is only used during part of the process or if the vent has pressure relief settings;
3. The value obtained by multiplying the hours per batch times the batches per year was selected if it gave a lower value than the hours per day times the days per year. The selected value is the minimum number of hours that the process could be operating; the higher value may indicate that there are gaps between batches;
4. The value obtained by multiplying the hours per day times the days per year was selected if it gave a lower value than the hours per batch times the batches per year. The difference suggests that the batches overlap. Therefore, the selected value corresponds with the number of hours that a control device would need to operate;

5. If the hours per batch and batches per year were the only data provided, and the product of these values exceeded 8,760 hours per year, the selected value was 8,760 hours per year.

Table 2 also presents uncontrolled (or precontrol) and controlled annual emissions for each of the 93 processes. The emissions data that were provided by the plants were classified in Table 2 as: (1) chlorinated organics, (2) unchlorinated organics, (3) HCl, (4) other, and (5) total. The processes in Table 2 are ranked according to their uncontrolled total annual emissions. Emissions data were not provided for six processes, although emissions were reported to be small for all six. Of the remaining 87 processes, 84 have organic HAP emissions and 34 have HCl emissions. Thirty-one of these processes have both organic HAP and HCl emissions. There are 53 processes that emit organic HAP but have no HCl emissions; three processes have HCl emissions but do not emit organic HAP.

There are a total of 72 processes with organic HAP emissions greater than or equal to 0.15 Mg/yr. The majority of processes with low uncontrolled organic HAP emissions are not controlled. Of the 23 processes with the lowest uncontrolled organic HAP emissions, 11 are controlled and 12 are uncontrolled. Of the lowest 12 processes (based on uncontrolled organic HAP emissions), 3 processes are controlled and 9 are uncontrolled.

There are 16 processes with HCl emissions greater than or equal to 6.8 Mg/yr. Of these 16, 11 are controlled to 94 percent or greater and 5 are controlled to less than 94 percent.

Many of the reported control efficiencies for gaseous organic HAP emissions were above 98 percent. The facilities using combustion-based control devices were contacted to discuss the basis for the reported control efficiencies. These facilities indicated that they did not conduct emissions tests when only process vent emissions were routed to the control devices. The reported control efficiencies were based on trial burns for demonstrating compliance with the hazardous waste incineration regulations, tests when burning multiple types of waste or emission streams, or on manufacturer guarantees.[2] The control efficiencies were revised based on analysis of the original data from the Section 114 response, follow-up contact with the plants, and other information. The controlled emissions shown in Table 2 are based on the revised control efficiencies.

III. Equipment Leaks

Nine of the plants provided equipment counts for 30 of the 93 processes. A summary of the equipment counts is presented in Table 3. Nineteen of the processes are batch processes and 11 are continuous processes. Information on valves in gas and

liquid service was provided for 17 of the processes; only the total number of valves was provided for the other 13 processes.

According to 40 CFR part 63 subpart H [part of the hazardous organic NESHAP (HON) for the synthetic organic chemicals manufacturing industry], liquid valves and pumps may be in either light liquid service or heavy liquid service. Light liquid service for equipment components means a piece of equipment in organic HAP service meets the following conditions: (1) the vapor pressure of one or more of the organic compounds is greater than 0.3 kilopascals (kPa) at 20°C, (2) the total concentration of the pure organic compound(s) having a vapor pressure greater than 0.3 kPa at 20°C is equal to or greater than 20 percent by weight of the total process stream, and (3) the fluid is a liquid at operating conditions.[3]

Seventy-eight of the 84 processes with organic HAP emissions use at least one HAP that would satisfy the vapor pressure condition for light liquid service. Because seven of the nine plants that provided equipment count data were implementing leak detection and repair (LDAR) programs, it is likely that they reported only those components that are in contact with a liquid process fluid at the operating conditions. The concentration of HAP in the process fluid in contact with the components was not provided. However, based on the prevalence of compounds that satisfy the vapor pressure criterion, it was assumed that all of the liquid valves and pumps are in light liquid service.

Modelling of equipment counts and operating hours is needed to estimate annual fugitive emissions for 60 of the 93 processes. Therefore, uncontrolled and controlled equipment leak emissions estimates for these processes are presented in the baseline emissions memorandum rather than in this memorandum.[4]

IV. Storage Tanks

Sixteen of the plants provided information on 102 storage tanks that contain 30 HAP compounds. All storage tanks reported are fixed roof tanks. These storage tanks consist of 80 organic HAP tanks, 2 hydrazine hydrate tanks, 18 HCl tanks, and 2 phosphorus tanks (molten phosphorus). Table 4 lists the HAP compounds that are stored in the PAI production industry and the uncontrolled and controlled emission level for each HAP. Sixteen of the 20 plants (80 percent) have organic HAP storage tanks. Hydrochloric acid storage tanks are located at 7 facilities (35 percent). Table 5 describes the number and percentage of organic HAP tanks based on tank capacity and vapor pressure parameters; Table 6 describes the number and percentage of organic HAP tanks based on tank capacity and uncontrolled emissions. Average values for various tank parameters are provided in Table 7.

Vapor pressures for pure component storage tanks were calculated using Antoine's equation and constants, virial equations of state, or other generally available sources of information. Raoult's Law and Henry's Law were used to calculate partial pressures for mixtures of components. The uncontrolled emissions from each organic HAP storage tank were calculated using EPA's TANKS3 program (User's Guide to TANKS, Storage Tank Emissions Calculation Software, February 20, 1996, EIB/OAQPS/EPA).[5]

A number of control devices are used to reduce HAP emissions from storage tanks. Table 8 contains a list of control devices used for storage tanks in the PAI manufacturing industry; this table identifies the type of HAP controlled and provides a range of control level achieved by the device. The uncontrolled and controlled emissions and the percent reduction for each facility are shown in Table 9. From the tank information provided, the total uncontrolled emissions from organic storage tanks at these 16 plants are 56.9 Mg/yr and the total controlled emissions are 9.02 Mg/yr.

Other regulations, such as the HON and pharmaceuticals NESHAP, have established capacity and vapor pressure applicability cutoffs in their requirements. All 82 tanks at the surveyed PAI plants are listed in Table 10 along with each control device, control efficiency, and the uncontrolled and controlled emissions. There are 68 storage tanks in the PAI manufacturing data base with capacity greater than or equal to 38 cubic meters (m^3) (10,000 gallons). These 68 tanks are located at 16 plants. Storage tanks greater than or equal to 38 m^3 (10,000 gallons) account for 98 percent of the uncontrolled storage tank emissions and 93 percent of the controlled storage tank emissions at the facilities in the data base.

V. Wastewater Systems

Sixteen of the 20 plants provided data on wastewater streams for 45 of the 93 processes. Table 11 lists the 28 HAP that were reported to be in the wastewater streams. Toluene, methanol, xylenes, and HCl were contained in the most streams. Annual loadings for methanol, ethylene dichloride, and HCl were significantly higher than loadings for other compounds; ethylene dichloride annual loading from two processes at one plant ranked second behind methanol.

Not all of the HAP loading has the potential to volatilize from wastewater. For the HON, extensive modeling analyses were conducted to estimate the fraction of each HAP loading that might volatilize from typical collection and biotreatment systems. These fractions, or Fe values, were used to determine which HAP would be subject to the standards. A total of 76 HAP in the HON had Fe values that indicated a significant fraction of the loading would be emitted; these HAP were listed in Table 9 of the

HON, and streams that contained them were subject to the standards. Wastewater streams with HAP that were not Table 9 compounds in the HON were not subject to the rule because their low Fe values indicated that they would not be emitted in significant quantities from collection and biotreatment systems. In addition, the organic HAP with low Fe values also readily degrade in biological treatment units. Of the 28 HAP in Table 11, 19 are Table 9 compounds in the HON. Compounds that are not Table 9 compounds in the HON include chloroacetic acid, cyanides, ethylene glycol, ethylene glycol mono butyl ether, formaldehyde, HCl, hydrogen cyanide, and phenol. One HAP was identified by the generic term "glycol ether." This compound is a Table 9 compound in the HON if it is ethylene glycol dimethyl ether; all other glycol ethers are not Table 9 compounds in the HON.

In many cases, it was not clear if the respondents were providing information for an aggregated stream or if only one wastewater stream was generated from each process. For ten of the processes (processes 13, 14, 15, 16, 17, 18, 22, 35, 37, and 38), the plant reported information for several individual wastewater streams for each process. Data for individual streams from these eight processes are provided in Table 12. To put all of the data on the same basis, these individual wastewater streams for a given process were aggregated. Table 13 shows data on the 45 aggregated streams with compounds in Table 9 of the HON at the 16 PAI production facilities.

Wastewater streams from 29 of the 45 processes receive onsite biological treatment and are discharged directly to nearby waterways. Four plants also treat streams from 13 of these 29 processes with activated carbon before biological treatment. The stream from 1 of the 29 processes is treated with steam stripping; the overheads are incinerated and the bottoms are sent for biological treatment. Streams from 4 of the 45 processes receive no onsite treatment or only neutralization before indirect discharge to publicly owned treatment works (POTW's). The streams from 2 processes are disposed of by deepwell injection. Streams from 9 processes are treated by incineration. The stream from 1 process is sent to an air stripper, and the resulting vapors are incinerated.

In previous regulations (and regulations under development), biodegradation technology was assigned a level of zero percent control in MACT floor analyses, although it is allowed as a technology for complying with the control requirements for wastewater. A control level above zero was assigned only when other treatment methods (e.g., steam stripping or incineration) were used. The same approach was used in this analysis.

As noted above, not all of the HAP in the wastewater has a potential to volatilize. Therefore, uncontrolled emissions were

estimated to be equal to the HAP loading times the respective Fe value. The Fe values that were developed for the HON are shown in Table 13 for each HAP in wastewater streams from PAI manufacturing facilities. The resulting uncontrolled emission estimates are also shown in Table 13.

Controls are assumed to be installed upstream of, or in place of, the biotreatment system. Therefore, controlled emissions were estimated by a two step process. First, an assumed efficiency of the control technology was multiplied by the HAP loading. Second, the remaining HAP in the wastewater after control was multiplied by the Fe. This two step procedure is equivalent to multiplying the uncontrolled emissions by the assumed efficiency of the control technology. For the incinerator used at plant 11, the control efficiency on multiple organics was assumed to be 99 percent (a scrubber is used to control HCl that is formed from combustion of chlorinated organics).[2] Based on the fraction removed (Fr) analysis for the HON, the steam stripper at plant 13 was assumed to have a control efficiency of 31 percent on methanol. At plant 10, air stripping was assumed to have a control efficiency of 95 percent on carbon tetrachloride and tetrachloroethylene. The resulting controlled emissions estimates are shown in Table 13.

VI. Bag Dumps and Product Dryers

Two of the 20 plants reported particulate matter (PM) HAP emissions. One plant emitted maleic anhydride from a bag dump used to introduce the raw material into the process. The second plant emitted captan from a product dryer. Table 14 presents the HAP compounds and emissions from bag dumps and product dryers.

TABLE 1. LIST OF HAP COMPOUNDS FROM PROCESS VENTS[a]

HAP[b]	No. of plants	No. of processes	Uncontrolled emissions, Mg/yr	Controlled emissions, Mg/yr	Percent reduction, %
1,3-Butadiene	1	1	33.0	0.660	98
Acetonitrile	2	3	86.3	2.69	97
Aniline	1	1	0.009	0.009	0
Benzene	2	3	92.7	3.41	96
Benzyl chloride	1	4	1.39	1.39	0
Carbon disulfide	2	2	29.1	14.3	51
Carbon tetrachloride	5	7	66.0	16.5	75
Chlorine	5	8	95.9	2.38	98
Chloroform	1	1	0.142	0.142	0
Cyanides					
Unspecified	1	4	30.3	0.003	99.99
Hydrogen cyanide	1	1	7.71	0.001	99.89
Ethyl benzene	1	5	1.13	0.023	98
Ethyl chloride	2	3	27.1	3.60	87
Ethylene dichloride	2	8	167	4.54	97
Formaldehyde	3	9	2.63	0.386	85
Glycol ethers					
Unspecified	1	1	0.916	0.027	97
Ethylene glycol butyl ether	1	1	0.068	0.068	0
HCl	11	36	4,050	301	93
Hexachlorobenzene	1	1	0.005	c	99.91
Hexachlorocyclopentadiene	1	1	0.045	0.005	90
Hexachloroethane	1	1	2.85	0.057	98
Hexane	2	2	24.7	3.14	87
Hydrazine	1	1	0.091	0.091	0
Hydroquinone	1	1	c	c	0
Maleic anhydride	1	2	0.149	0.149	0
Methanol	10	23	405	80.4	80
Methyl chloride	3	4	115	51.1	56
Methyl ethyl ketone	1	1	18.9	0.668	96
Methyl isobutyl ketone	2	5	59.4	21.9	63
Methyl isocyanate	1	1	1.10	0.022	98
Methylene chloride	3	3	41.1	18.2	56
N,N-Dimethylaniline	1	1	34.3	0.171	99.5
Phosgene	2	7	2,350	48.8	97
Tetrachloroethylene	2	2	59.7	9.80	84
Toluene	7	32	496	151	70
Trichlorobenzene	2	2	0.444	0.314	29

TABLE 1. (continued)

HAP[b]	No. of plants	No. of processes	Uncontrolled emissions, Mg/yr	Controlled emissions, Mg/yr	Percent reduction, %
Trichloroethylene	2	2	18.2	0.609	97
Triethylamine	1	2	56.2	17.3	69
Xylene	4	15	135	21.7	84
TOTAL			8,510	777	91

[a]HAP emitted from 93 processes at 20 plants.
[b]HCl, chlorine, hydrogen cyanide, and hydrazine are inorganic; the other HAP are VOC's.
[c]Emissions are less than 0.0001 Mg/yr

TABLE 2. SUMMARY OF PROCESS VENT EMISSIONS

Plant no. (a)	Process no.	AI/ IN	B/C	Process operating hr/yr	Uncontrolled emissions, Mg/yr					Controlled emissions, Mg/yr				
					Chlorinated organics	Unchlor-inated	HCl (b)	Other (c)	Total	Chlorinated organics	Unchlor-inated	HCl	Other (a)	Total
3	10	AI	B	904	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
15	53	AI	B	192	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
3	8	IN	B	3,312	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
8	21	AI	B	2,208	0	0	(d)	0	(d)	0	0	(d)	0	(d)
13	41	AI	B	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
3	5	AI	B	7,809	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
15	52	AI	B	120	0	0	9.80E-06	0	9.80E-06	0	0	9.80E-06	0	9.80E-06
15	55	AI	B	8,160	0	0.000245	0.000962	0	0.00121	0	0.000245	0.000962	0	0.00121
15	49	AI	B	840	0	0.00127	0	0	0.00127	0	0.00127	0	0	0.00127
10	26	AI	B	7,296	0.00499	0	0	0	0.00499	4.54E-06	0	0	0	4.54E-06
23	87	IN	B	567	0	0.00953	0	0	0.00953	0	0.00953	0	0	0.00953
15	48	AI	B	960	0	0.0133	5.90E-05	0	0.0134	0	0.0133	5.90E-05	0	0.0134
15	50	AI	B	96	0	0.0237	0	0	0.0237	0	0.0237	0	0	0.0237
3	9	AI	B	1,425	0	0.0245	0	0	0.0245	0	0.0245	0	0	0.0245
15	51	AI	B	192	0	0.0474	0	0	0.0474	0	0.0142	0	0	0.0142
3	13	AI	B	5,040	0	0.0676	0	0	0.0676	0	0.0676	0	0	0.0676
15	56	AI	B	360	0	0.0855	0	0	0.0855	0	0.0855	0	0	0.0855
11	35	AI	B/C	3,588	0	0.154	0	0	0.154	0	0.00308	0	0	0.00308
23	88	AI	B	340	0.00181	0.0499	0.104	0	0.156	0.000454	0.0150	0.00318	0	0.0186
20	65	AI	B	2,200	0	0.146	0	0.0907	0.237	0	0.146	0	0.0907	0.237
15	57	AI	B	3,960	0	0.276	0	0	0.276	0	0.276	0	0	0.276
17	60	AI	B	1,548	0.337	0	0	0	0.337	0.00674	0	0	0	0.00674
11	34	AI	B/C	1,600	0	0.354	0	0	0.354	0	0.00708	0	0	0.00708
11	36	IN	B	7,776	0	0.399	0	0	0.399	0	0.00798	0	0	0.00798
21	70	AI	B	127	0	0.447	0	0	0.447	0	0.0650	0	0	0.0650

TABLE 2. SUMMARY OF PROCESS VENT EMISSIONS (continued)

Plant no. (a)	Process no.	AI/ IN	B/C	Process operating hr/yr	Uncontrolled emissions, Mg/yr					Controlled emissions, Mg/yr				
					Chlorinated organics	Unchlor-inated	HCl (b)	Other (c)	Total	Chlorinated organics	Unchlor-inated	HCl	Other (a)	Total
23	90	AI	B	1,340	0.00771	0.198	0.410	0	0.616	0.00227	0.0594	0.0122	0	0.0739
15	58	AI	B	5,220	0	0.679	0	0	0.679	0	0.679	0	0	0.679
3	7	IN	B	8,160	0.693	0	0	0	0.693	0.693	0	0	0	0.693
3	12	AI	B	4,176	0	0.782	0	0	0.782	0	0.0780	0	0	0.0780
21	71	AI	B	148	0	0.820	0	0	0.820	0	0.119	0	0	0.119
21	72	AI	B	169	0	0.857	0	0	0.857	0	0.125	0	0	0.125
5	14	IN	C	7,464	0	0.916	0	0	0.916	0	0.0272	0	0	0.0272
21	73	AI	B	189	0	0.969	0	0	0.969	0	0.141	0	0	0.141
14	46	AI	B	288	0	1.00	0	0	1.00	0	0.0199	0	0	0.0199
23	89	AI	B	2,320	0.0132	0.342	0.710	0	1.07	0.00408	0.103	0.0209	0	0.127
22	81	AI	B	300	0	1.38	0	0	1.38	0	0.0276	0	0	0.0276
8	22	AI	B	2,208	0	1.41	(d)	0	1.41	0	0.141	(d)	0	0.141
14	43	AI	B	792	0	1.74	0	0	1.74	0	0.0345	0	0	0.0345
15	54	AI	B	5,784	0	1.59	0.157	0	1.74	0	1.59	0.157	0	1.74
14	44	AI	B	696	0	1.76	0	0	1.76	0	0.0351	0	0	0.0351
22	80	IN	C	456	0	1.81	0	0	1.81	0	0.0363	0	0	0.0363
23	92	AI	B	360	0.486	1.39	0.000950	0	1.88	0.00971	0.0279	9.43E-06	0	0.0376
14	47	AI	B	576	0	2.28	0	0	2.28	0	0.0458	0	0	0.0458
14	45	AI	B	840	0	3.19	0	0	3.19	0	0.0642	0	0	0.0642
22	76	IN	B	1,776	0	4.54	0	0	4.54	0	0.0907	0	0	0.0907
22	77	IN	B	1,184	0	4.54	0	0	4.54	0	0.0907	0	0	0.0907
1	2	AI	C	336	0.0459	5.59	0.0262	0	5.66	0.0459	3.25	0.0131	0	3.31
21	69	AI	B	570	0	5.81	0	0	5.81	0	0.938	0	0	0.938
17	61	AI	C	1,920	0	8.19	0	0	8.19	0	0.164	0	0	0.164
1	4	AI	C	720	0.0751	9.14	0.0428	0	9.26	0.0751	5.32	0.0214	0	5.42

TABLE 2. SUMMARY OF PROCESS VENT EMISSIONS (continued)

Plant no. (a)	Process no.	AI/ IN	B/C	Process operating hr/yr	Uncontrolled emissions, Mg/yr					Controlled emissions, Mg/yr				
					Chlorinated organics	Unchlor-inated	HCl (b)	Other (c)	Total	Chlorinated organics	Unchlor-inated	HCl	Other (a)	Total
3	11	IN	B	8,160	0	0.403	9.00	0	9.41	0	0.00806	0.0900	0	0.0981
7	18	AI	C	5,300	0.181	12.6	0	0	12.8	0.181	12.6	0	0	12.8
8	23	AI	C	7,896	0	0	14.5	0	14.5	0	0	1.21	0	1.21
17	62	AI	C	2,424	0	15.3	0	0	15.3	0	2.91	0	0	2.91
12	37	AI	B	1,368	0	4.59	11.0	0	15.6	0	0.0918	0.110	0	0.202
11	28	AI	B/C	1,272	0	16.1	0	0	16.1	0	5.33	0	0	5.33
6	16	AI	B	4,404	0	16.5	0	0	16.5	0	1.65	0	0	1.65
13	42	AI	B/C	8,760	0	18.9	0	0	18.9	0	0.668	0	0	0.668
1	3	AI	C	720	0.158	19.3	0.0904	0	19.5	0.158	11.2	0.0452	0	11.4
8	20	AI	B	2,088	0.0454	15.2	6.80	0	22.1	0.00454	1.52	0.680	0	2.21
22	78	AI	B	1,036	0	23.8	0	0	23.8	0	0.475	0	0	0.475
21	68	AI	B	4,056	0	28.5	0	0	28.5	0	4.14	0	0	4.14
22	83	AI	B	1,946	22.7	6.27	0	0	28.9	0.454	0.125	0	0	0.579
12	38	(b)	B	1,170	0	24.3	0.000136	7.71	32.0	0	0.504	1.36E-06	0.00857	0.512
10	27	IN	C	7,680	31.3	0	0	1.39	32.7	23.0	0	0.000907	0.274	23.3
7	17	IN	B	6,072	0	33.0	0	0	33.0	0	0.660	0	0	0.660
19	64	AI	B	6,318	0	34.3	0	0	34.3	0	0.171	0	0	0.171
11	30	AI	B/C	3,072	0	48.3	0	0	48.3	0	16.0	0	0	16.0
3	6	AI	C	8,136	50.9	0	0	0	50.9	2.03	0	0	0	2.03
5	15	AI	B	6,039	42.8	9.05	0	0	51.9	42.8	9.05	0	0	51.9
22	82	AI	B	8,760	45.4	12.2	0	0	57.5	0.907	0.242	0	0	1.15
23	93	AI	B	4,150	40.1	18.6	0.557	0	59.2	7.65	5.90	0.0146	0	13.6
11	29	AI	B/C	3,792	0	59.5	0	0	59.5	0	19.7	0	0	19.7
22	79	IN	B	432	8.30	0	54.4	0	62.8	0.166	0	0.567	0	0.733
11	33	IN	C	7,176	60.3	4.41	0.761	0	65.5	1.21	4.04	0.00761	0	5.25

TABLE 2. SUMMARY OF PROCESS VENT EMISSIONS (continued)

Plant no. (a)	Process no.	AI/ IN	B/C	Process operating hr/yr	Uncontrolled emissions, Mg/yr					Controlled emissions, Mg/yr				
					Chlorinated organics	Unchlor-inated	HCl (b)	Other (c)	Total	Chlorinated organics	Unchlor-inated	HCl	Other (a)	Total
22	85	AI	B	1,542	0	66.7	0	0	66.7	0	1.33	0	0	1.33
12	40	AI	B	1,568	32.8	15.4	26.7	0	74.9	0.919	2.19	0.0667	0	3.18
20	66	AI	B	840	0	81.8	0	0	81.8	0	0.810	0	0	0.810
11	31	AI	B/C	7,104	40.7	51.5	0	0	92.2	18.2	21.8	0	0	40.0
22	84	AI	B	2,496	0	96.3	0.101	0	96.4	0	1.93	0.101	0	2.03
23	94	AI	B	4,370	26.5	38.5	33.1	0	98.1	3.35	11.8	0.357	0	15.5
11	32	AI	B/C	7,176	103	7.52	1.30	0	112	2.05	6.87	0.0130	0	8.94
23	91	IN	C	7,488	4.02	0	117	0	121	1.38	0	1.17	0	2.55
1	1	AI	C	5,040	1.11	135	0.633	0	137	1.11	78.7	0.317	0	80.1
21	67	AI	B	8,400	0	129	12.0	0	141	0	63.5	2.36	0	65.9
9	25	AI	C	3,384	18.2	0	174	0	192	0.364	0	0.174	0	0.538
17	63	AI	C	8,064	0	200	0	0	200	0	5.22	0	0	5.22
8	19	AI	C	7,896	0.0431	202	13.2	0	215	0.0431	12.9	1.32	0	14.3
12	39	AI	C	7,000	199	0	67.2	0	266	5.93	0	1.03	0	6.96
9	24	AI	B	5,568	0	0	356	0	356	0	0	0.356	0	0.356
22	75	AI	B	4,500	53.1	0	349	0	402	1.06	0	3.66	0	4.72
22	86	IN	B	(d)	1,730	0	535	0	2,260	34.5	0	267	0	302
22	74	AI	C	5,184	347	0	2,360	0	2,710	6.94	0	23.7	0	30.6

(a) This table shows processes 1 through 58 and processes 60 through 94; process 59 was omitted after the initial analysis.
(b) This column includes both HCl and chlorine.
(c) Others include hydrazine, hydrogen cyanide, and maleic anhydride.
(d) No data provided.

TABLE 3. SUMMARY OF EQUIPMENT COMPONENT COUNTS

Process number (a)	Batch or continuous	Number of components						
		Flanges	Pumps	Valves	Gas valves	Liquid valves	Sampling connections	Others
1	B	0	0		0	32	11	
2	B	44	0	8				
3	B	44	0	8				
4	B	100	1		6	20	4	16
5	B	192	0		50	323	0	22
6	B	252	3		61	75	3	2
7	B	372	6	161				
8	B	506	7	206				
9	B	593	11		4	218	16	5
10	B	810	2		11	231	2	
11	B	812	4		76	154	6	10
12	B	914	14	362				
13	B	1,098	5		43	278	9	4
14	B	1,140	1		126	294	12	3
15	B	1,453	20	443				
16	B	2,839	44	952				
17	B	2,979	33	956				
18	B	3,528	53	1,300				
19	B	3,528	53	1,300				
20	C	0	13	538				17
21	C	0	128	4,735			22	264
22	C	980	7		19	392	53	6
23	C	1,284	4		35	508	0	0
24	C	1,500	33		278	954		
25	C	1,500	33		278	954		
26	C	1,500	33		278	954		
27	C	1,500	33		278	954		
28	C	2,591	28		260	1,330	0	0
29	C	2,604	22		251	1,004	0	0
30	C	2,740	27	1,108			12	81

(a) These process numbers are for convenience; they do not correspond with the process numbers in Table 2.

TABLE 4. LIST OF HAP COMPOUNDS IN STORAGE TANKS

HAP	No. of tanks[a]	Uncontrolled emissions, kg/yr	Controlled emissions, kg/yr	Percent reduction, %
Acetonitrile	1	62.2	62.2	0
Aniline	2	0.653	0.653	0
Carbon tetrachloride	4	2,720	54.1	98
Chloroacetic acid	1	0.000	0.000	---
Cyanides				
Cyanohydrin	1	0.721	0.014	98
Cyanuric chloride	2	0.000	0.000	---
Dimethyl hydrazine	2	356	356	0
Ethyl benzene	1	1.23	0.025	98
Ethylene dichloride	2	4,590	91.7	98
Ethylene glycol	4	0.163	0.163	0
Formaldehyde	3	228	223	2
Glycol ethers				
Unspecified	3	2,000	40.1	98
Butyl Cellosolve	2	1.72	1.72	0
Hexachlorobenzene	2	0.000	0.000	---
Hexachloroethane	2	0.082	0.002	98
Hexane	2	381	348	8
HCl	18	---	---	---
Hydrazine	2	42.8	42.8	0
Maleic anhydride	2	67.9	12.7	81
Methanol	14	4,370	3,020	31
Methyl ethyl ketone	1	269	269	0
Methylene chloride	2	582	533	9
Methyl isobutyl ketone	1	45.6	5.02	89
Phosphorus	2	---	---	---
Tetrachloroethylene	5	418	8.37	98
Toluene	23	37,600	2,060	95
Trichlorobenzene	4	169	169	0.1
Trichloroethylene	1	752	752	0
Triethylamine	1	0.531	0.531	0
Xylene	10	2,210	969	56
TOTAL		56,900	9,020	84

[a]The number of tanks shown in this column will not sum to 102; some tanks contain more than one HAP compound.

TABLE 5. DISTRIBUTION OF STORAGE TANKS BY CAPACITY AND HAP VAPOR PRESSURE

Tank capacity, gallons	HAP vapor pressure, psia					Sum of tanks	Percentage of total
	<0.1	≥0.1 to <0.5	≥0.5 to <0.75	≥0.75 to >1.9	≥1.9		
<7,000	1	3	1	0	1	6	7.3%
≥7,000, <10,000	3	2	2	0	1	8	9.8%
≥10,000, <20,000	3	4	9	4	7	27	33%
≥20,000, <30,000	3	2	0	2	1	8	9.8%
≥30,000, <40,000	3	5	2	2	1	13	16%
≥40,000	4	6	3	4	3	20	24%
Sum of tanks	18	22	17	12	14	82	100%
Percentage of total	22%	27%	21%	15%	17%	100%	

TABLE 6. DISTRIBUTION OF STORAGE TANKS BY CAPACITY AND UNCONTROLLED HAP EMISSIONS

Tank capacity, gallons	Uncontrolled HAP emissions, lb					Sum of tanks	Percentage of total
	<1	>=1 to <250	≥250 to <1,000	≥1,000 to <7,000	≥7,000		
<7,000	1	3	1	1	0	6	7.3%
≥7,000, <10,000	3	4	1	0	0	8	9.8%
≥10,000, <20,000	1	11	10	5	0	27	33%
≥20,000, <30,000	2	3	1	2	0	8	9.8%
≥30,000, <40,000	0	7	4	2	0	13	16%
≥40,000	0	4	4	7	5	20	24%
Sum of tanks	7	32	21	17	5	82	100%
Percentage of total	8.5%	39%	26%	21%	6.1%	100%	

TABLE 7. AVERAGE PARAMETERS FOR ORGANIC STORAGE TANKS

Parameter		
Tank size, gallons	Minimum	2,500
	Maximum	1,567,000
	Average	76,360
Throughput, gallons	Minimum	600
	Maximum	64,000,000
	Average	3,796,000
Vapor pressure, psia	Minimum	0.00
	Maximum	7.92
	Average	0.92

TABLE 8. CONTROL DEVICES USED FOR STORAGE TANKS

Control device	Compound controlled	Range of control, %
Carbon adsorber	Organic	95-98
Scrubber		
Water	Organic	90-99.5
	HCl	90-99
Caustic	HCl	96
Combustion (Incinerator, BIF Boiler, RCRA Incinerator, Thermal Oxidizer)	Organic	98
	Chlorinated organic	98
Flare	Organic	98
Condenser	Organic	13-89
	Chlorinated organic	4
Closed vent system	HCl	None provided

TABLE 9. UNCONTROLLED AND CONTROLLED ORGANIC HAP EMISSIONS FROM STORAGE TANKS PER PLANT

PLANT	NO. ORGANIC TANKS	UNCONTROLLED ORGANIC EMISSIONS, KG/YR	CONTROLLED ORGANIC EMISSIONS, KG/YR	PERCENT REDUCTION
1	5	33,100	1,660	95%
3	5	87.0	10.7	88%
5	3	2,000	40.1	98%
7	1	55.5	0.277	99.5%
8	9	973	943	3%
10	5	3,140	62.7	98%
11	10	6,930	1,870	73%
12	13	1,830	1,120	39%
13	1	269	269	0%
14	5	1,160	23.3	98%
15	3	83.2	83.2	0%
17	1	0.0091	0.0091	0%
20	6	473	473	0%
21	8	4,360	731	83%
22	2	636	12.7	98%
23	5	1,740	1,740	0%
TOTAL	82	56,900	9,020	84%

TABLE 10. UNCONTROLLED AND CONTROLLED EMISSIONS FROM STORAGE TANKS

Plan	Tank Size, gal	Throughput, gal	Vapor pressure, psia	Uncontrolled emissions, kg/yr	Control device (a)	Control efficiency %	Controlled emissions, kg/yr
1	6,000	60,000	0.5494	45.1	CA	95.00	2.25
1	500,000	56,000,000	0.5494	11,500	CA	95.00	576
1	500,000	56,000,000	0.5494	11,500	CA	95.00	576
1	500,000	64,000,000	0.3469	5,020	CA	95.00	251
1	500,000	64,000,000	0.3469	5,020	CA	95.00	251
3	2,500	9,800	0.0002	0.000	NONE	0.00	0.000
3	14,000	119,000	0.0052	0.535	NONE	0.00	0.535
3	7,500	38,000	2.4155	31.8	SC	90.00	3.18
3	10,000	81,000	2.4155	52.9	SC	90.00	5.29
3	22,000	262,940	0.0139	1.72	NONE	0.00	1.72
5	66,000	176,440	1.5235	669	SC	98.00	13.4
5	66,000	176,440	1.5235	669	SC	98.00	13.4
5	66,000	176,440	1.5235	669	SC	98.00	13.4
7	14,500	350,000	0.1812	55.5	SC	99.50	0.278
8	220,000	4,840,000	0.0082	98.2	SEAL POTS	0.00	98.2
8	35,000	175,000	0.4855	32.2	SEAL POTS	0.00	32.2
8	100,000	500,000	2.4155	692	SEAL POTS	0.00	692
8	500,000	1,000,000	0.0082	67.3	SEAL POTS	0.00	67.3
8	27,000	40,300	0.2267	49.7	SEAL POTS	0.00	49.7
8	7,000	77,000	0.0006	0.0363	SEAL POTS	0.00	0.0363
8	7,000	77,000	0.0006	0.0363	SEAL POTS	0.00	0.0363
8	7,000	224,000	0.0006	0.0816	SEAL POTS	0.00	0.0816
8	10,000	3,670	0.4329	34.4	SC	90.00	3.44
10	5,200	348,700	0.3499	121	INC	98.00	2.43
10	15,750	324,900	1.8742	1,050	INC	98.00	21.0
10	15,750	324,900	1.8742	1,050	INC	98.00	21.0
10	8,400	537,700	0.5381	283	INC	98.00	5.67
10	33,000	179,200	1.4285	631	INC	98.00	12.6
11	12,690	2,120,260	0.5254	231	CONDENSER	13.20	201
11	30,000	455,000	0.1284	43.8	SC-ACID/SC-CAUSTIC/INC	98.00	0.877
11	7,900	175,000	0.373	45.6	CONDENSER	89.00	5.02
11	6,540	52,980	7.9181	554	CONDENSER	4.00	532
11	13,500	322,530	0.5302	118	CONDENSER	41.00	69.5
11	13,500	755,800	2.2488	260	CONDENSER	42.00	151
11	1,567,000	5,342,000	0.2233	1,090	CONDENSER	25.00	816
11	144,000	2,890,000	1.4824	3,220	INC	98.00	64.5
11	27,000	3,140,000	1.4824	1,360	INC	98.00	27.3
11	30,600	815,000	0.0715	7.05	THERMAL OXIDIZER	98.00	0.141
12	40,000	31,000	0.5494	127	BIF BOILER	98.00	2.55
12	32,000	79,000	0.5494	116	BIF BOILER	98.00	2.32
12	84,000	68,000	0.2686	108	BIF BOILER	98.00	2.15
12	40,000	56,000	0.0565	16.6	BIF BOILER	98.00	0.331
12	10,500	33,000	2.4155	76.8	BIF BOILER	98.00	1.54
12	7,000	11,000	0.058	0.376	BIF BOILER	98.00	0.0075
12	10,300	75,000	0.5494	63.9	BIF BOILER	98.00	1.28
12	10,300	213,000	0.5494	124	BIF BOILER	98.00	2.48
12	10,300	111,000	0.456	65.6	BIF BOILER	98.00	1.31
12	30,000	31,200	0.0082	3.40	NONE	0.00	3.40
12	20,000	33,800	2.9292	348	NONE	0.00	348
12	7,500	7,800	0.7432	32.8	RCRA INC	98.00	0.656

TABLE 10. UNCONTROLLED AND CONTROLLED EMISSIONS FROM STORAGE TANKS

Plan	Tank Size, gal	Throughput, gal	Vapor pressure, psia	Uncontrolled emissions, kg/yr	Control device (a)	Control efficiency %	Controlled emissions, kg/yr
12	20,000	369,000	1.3353	752	NONE	0.00	752
13	17,500	160,000	1.7443	269	NONE	0.00	269
14	47,000	620,800	0.2267	223	FLARE	98.00	4.46
14	32,000	747,310	0.2267	242	FLARE	98.00	4.85
14	47,000	1,226,040	0.2267	394	FLARE	98.00	7.89
14	30,000	91,823	2.4155	186	FLARE	98.00	3.72
14	32,000	308,147	0.2267	118	FLARE	98.00	2.36
15	5,313	146,160	0.2267	25.0	NONE	0.00	25.0
15	6,423	146,160	0.2267	25.6	NONE	0.00	25.6
15	12,847	146,160	0.2267	32.5	NONE	0.00	32.5
17	17,760	600	0.0002	9.07E-03	NONE	0.00	9.07E-03
20	25,600	119,742	0.1562	12.7	NONE	0.00	12.7
20	30,000	464,997	0.1562	30.0	NONE	0.00	30.0
20	16,000	177,681	0.0186	12.4	NONE	0.00	12.4
20	12,000	13,330	3.033	164	NONE	0.00	164
20	14,000	12,540	3.033	192	NONE	0.00	192
20	12,387	7,120	1.7824	62.2	NONE	0.00	62.2
21	15,000	213,950	2.4155	212	NONE	0.00	212
21	15,000	19,914	0.5494	50.0	NONE	0.00	50.0
21	30,000	2,250,000	1.195	575	FLARE	98.00	11.5
21	15,000	490,000	2.4155	394	NONE	0.00	394
21	15,000	10,800,000	0.5494	1,000	CA	98.00	20.1
21	15,000	3,640,000	0.5494	483	CA	98.00	9.67
21	15,000	1,810,000	0.5494	350	CA	98.00	7.00
21	15,000	14,700,000	0.5494	1,290	CA	98.00	25.8
22	31,600	68,478	0.5494	112	THERMAL OXIDIZER	98.00	2.24
22	102,000	288,954	2.4155	524	THERMAL OXIDIZER	98.00	10.5
23	20,000	20,540	0.013	0.327	NONE	0.00	0.327
23	20,000	20,540	0.013	0.327	NONE	0.00	0.327
23	75,000	816,334	2.4155	1,360	NONE	0.00	1,360
23	30,000	1,375,248	0.0042	4.08	NONE	0.00	4.08
23	50,000	3,069,544	0.0433	372	NONE	0.00	372
TOTAL				56,900			9,020

(a)SC = Scrubber
CA = Carbon adsorber
INC = Incinerator

TABLE 11. LIST OF HAP COMPOUNDS IN WASTEWATER STREAMS AT SURVEYED PLANTS

HAP	No. of plants	No. of processes	HAP load, Mg/yr	Uncontrolled HAP emissions, Mg/yr
Acetonitrile	2	2	73.7	26.5
Benzene	2	2	15.3	12.3
Carbon disulfide	1	1	0.907	0.835
Carbon tetrachloride	1	1	0.113	0.107
Chloroacetic acid[b]	1	1	108	---
Chloroform	2	3	2.24	1.75
Cyanides				
Unspecified[b]	1	1	19.5	---
Hydrogen cyanide[b]	1	1	a	---
Ethylene dichloride	1	2	760	486
Ethylene glycol[b]	2	5	4.77	---
Formaldehyde[b]	2	4	59.2	---
Glycol ethers				
Unspecified	1	1	6.78	2.17
Ethylene glycol mono butyl ether[b]	1	1	1.53	---
HCl[b]	7	9	622	---
Hexachlorobenzene	1	1	0.0050	0.0032
Hexane	1	1	0.0356	0.0356
Methanol	8	16	1,950	331
Methyl chloroform	1	1	0.0009	0.0008
Methyl ethyl ketone	1	1	51.3	24.6
Methyl isobutyl ketone	2	4	152	80.6
Methylene chloride	2	2	205	158
N,N-Dimethylaniline	1	1	34.1	11.6
Naphthalene	1	1	0.0043	0.0022
Phenol[b]	1	1	0.0004	---
Tetrachloroethylene	1	1	0.0680	0.0626
Toluene	6	21	88.7	71.0
Trichlorobenzene	2	2	7.39	4.73
Xylene	5	9	20.0	16.0
TOTAL			3,370	1,230

[a]The surveyed plant indicated that the load was "trace."
[b]These compounds are not Table 9 compounds in the HON and are not likely to volatilize from the wastewater streams.

TABLE 12. INDIVIDUAL WASTEWATER STREAMS FROM PROCESSES

Plant	Process	Wastewater stream number	HAP load, Mg/yr	Flow rate, gal/yr	Fe	HAP emissions, Mg/yr	
						Uncontrolled	Controlled
11	13	WW001	18.0	908,700	0.53	9.53	0.0953
11	13	WW001	2.54	908,700	0.80	2.03	0.0203
11	13	WW002	1.38	70,200	0.53	0.731	0.00731
11	13	WW002	0.195	70,200	0.80	0.156	0.00156
11	14	WW001	66.4	3,355,200	0.53	35.2	0.352
11	14	WW001	9.36	3,355,200	0.80	7.49	0.0749
11	14	WW002	5.09	259,200	0.53	2.70	0.0270
11	14	WW002	0.718	259,200	0.80	0.575	0.00575
11	15	WW001	54.0	2,726,100	0.53	28.6	0.286
11	15	WW001	7.61	2,726,100	0.80	6.09	0.0609
11	15	WW002	4.14	210,600	0.53	2.19	0.0219
11	15	WW002	0.584	210,600	0.80	0.467	0.00467
11	16	WW001	728	4,400,000	0.17	124	1.24
11	16	WW001	161	4,400,000	0.77	124	1.24
11	16	WW001	11.6	4,400,000	0.80	9.30	0.0930
11	16	WW002	195	1,200,000	0.17	33.2	0.332
11	16	WW002	43.3	1,200,000	0.77	33.4	0.334
11	16	WW002	3.12	1,200,000	0.80	2.50	0.0250
11	17	WW001	479	5,040,000	0.64	306	3.06
11	17	WW002	1.56	1,260,000	0.79	1.25	0.0125
11	18	WW001	281	2,960,000	0.64	180	1.80
11	18	WW002	0.916	740,000	0.79	0.733	0.00733
12	22	WW001	0.00694	3,600	0.80	0.00555	0.00555
12	22	WW002	0.327	159,000	0.80	0.261	0.261
12	22	WW003	0.0635	33,000	0.80	0.0508	0.0508
12	22	WW004	0.399	208,000	0.80	0.319	0.319
19	35	WW001	1.02	675,500	0.34	0.348	0.348
19	35	WW002	2.54	1,680,000	0.34	0.864	0.864
19	35	WW003	15.3	10,080,000	0.34	5.19	5.19
19	35	WW004	15.3	10,080,000	0.34	5.19	5.19
21	37	WW003	0.774	1,512,000	0.17	0.132	0.132
21	37	WW004	5.15	4,536,000	0.17	0.875	0.875
21	37	WW005	0.000295	85,909	0.17	0.000050	0.000050
21	37	WW006	0	1,008,000	0.17	0	0
21	37	WW008	145	2,520,000	0.17	24.6	24.60
21	37	WW009	81.6	1,260,000	0.17	13.9	13.88
21	37	WW009	0.00229	1,260,000	0.80	0.00183	0.00183

TABLE 12. INDIVIDUAL WASTEWATER STREAMS FROM PROCESSES (continued)

Plant	Process	Wastewater stream number	HAP load, Mg/yr	Flow rate, gal/yr	Fe	HAP emissions, Mg/yr	
						Uncontrolled	Controlled
21	37	WW011	97.3	14,408,000	0.17	16.5	16.5
21	37	WW011	11.3	14,408,000	0.80	9.00	9.00
21	37	WW012	0.0264	800	0.17	0.00448	0.00448
21	37	WW013	0.237	10,500	0.17	0.0403	0.0403
21	37	WW013	0.00513	10,500	0.80	0.00410	0.00410
21	37	WW014	0.0854	3,500	0.17	0.0145	0.0145
21	37	WW014	0.0582	3,500	0.80	0.0465	0.0465
21	37	WW015	143	22,166,000	0.17	24.3	24.3
21	37	WW015	6.28	22,166,000	0.80	5.02	5.02
21	37	WW018	0.405	140,000	0.17	0.0688	0.0688
21	37	WW019	0.215	157,500	0.17	0.0366	0.0366
21	38	WW001	87.5	5,250,000	0.17	14.9	14.9
21	38	WW001	3.32	5,250,000	0.80	2.66	2.66
21	38	WW002	0.125	30,100	0.17	0.0212	0.0212
21	38	WW002	0.0544	30,100	0.80	0.0435	0.0435
21	38	WW003	0.0431	145,950	0.17	0.00733	0.00733
21	38	WW003	0.136	145,950	0.80	0.109	0.109
21	38	WW004	0.00590	504,000	0.80	0.00472	0.00472

TABLE 13. SUMMARY OF WASTEWATER STREAMS

Plant	Process	Number of streams per process	HAP load, Mg/yr	Flow rate, gal/yr	Fe	HAP emissions, Mg/yr	
						Uncontrolled	Controlled
1	1	1	6.17	200,000,000	0.80	4.94	4.94
1	2	1	0.925	30,000,000	0.80	0.740	0.740
1	3	1	0.386	12,500,000	0.80	0.308	0.308
1	4	1	0.231	7,500,000	0.80	0.185	0.185
3	5	1	2.06	27,600,000	0.78	1.61	1.61
3	6	1	0.173	411,000	0.17	0.0294	0.0294
3	7	1	1.23	11,600	0.17	0.209	0.209
5	8	1	6.78	73,417,000	0.32	2.17	2.17
7	9	1	0.907	13,500,000	0.92	0.835	0.835
8 (a)	10	1	6.89	130,000,000	0.64	0.00	0.00
8 (a)	10	1	2.22	130,000,000	0.80	0.00	0.00
8 (a)	10	1	213	130,000,000	0.17	0.00	0.00
10	11	1	0.113	2,630,000	0.94	0.107	0.00533
10	11	1	0.0680	2,630,000	0.92	0.0626	0.00313
10	12	1	0.00499	36,981,000	0.64	0.00319	0.00319
11	13	2	19.4	978,900	0.53	10.3	0.103
11	13	2	2.73	978,900	0.80	2.18	0.0218
11	14	2	10.1	3,614,400	0.80	8.06	0.0806
11	14	2	71.5	3,614,400	0.53	37.9	0.379
11	15	2	8.19	2,936,700	0.80	6.55	0.0655
11	15	2	58.1	2,936,700	0.53	30.8	0.308
11	16	2	14.7	5,600,000	0.80	11.8	0.118
11	16	2	924	5,600,000	0.17	157	1.57
11	16	2	205	5,600,000	0.77	158	1.58
11	17	2	1.56	6,300,000	0.80	1.25	0.0125
11	17	2	479	6,300,000	0.79	306	3.06
11	18	2	0.916	3,700,000	0.80	0.733	0.00733
11	18	2	281	3,700,000	0.79	180	1.80

TABLE 13. SUMMARY OF WASTEWATER STREAMS (CONTINUED)

Plant	Process	Number of streams per process	HAP load, Mg/yr	Flow rate, gal/yr	Fe	HAP emissions, Mg/yr	
						Uncontrolled	Controlled
11	19	1	7.08	4,173,000	0.80	5.66	0.0566
11	19	1	13.4	4,173,000	0.17	2.29	0.0229
11	20	1	3.08	1,819,000	0.80	2.47	0.0247
11	20	1	5.86	1,819,000	0.17	0.996	0.0100
11	21	1	7.98	4,708,000	0.80	6.39	0.0639
11	21	1	15.2	4,708,000	0.17	2.58	0.0258
12	22	4	0.796	403,600	0.80	0.637	0.637
12	23	1	1.81	47,000	0.17	0.308	0.308
12	24	1	0.499	132,000	0.64	0.319	0.319
13	25	1	3.18	7,000,000	0.17	0.540	0.393
13	26	1	51.3	4,000,000	0.48	24.6	24.6
14	27	1	13.6	120,000	0.80	10.9	10.9
15	28	1	0.0508	1,824	0.80	0.0406	0.0406
15	29	1	0.349	5,625	0.80	0.279	0.279
15	30	1	0.192	1,028	0.80	0.154	0.154
15	31	1	0.385	2,056	0.80	0.308	0.308
15	32	1	10.7	1,857,100	0.80	8.57	8.57
17	33	1	0.247	4,026,000	0.77	0.190	0.190
17	33	1	0.179	4,026,000	0.78	0.140	0.140
17	34	1	0.0356	24,918,000	1.00	0.0356	0.0356
17	34	1	3.47	24,918,000	0.53	1.84	1.84
17	34	1	0.000122	24,918,000	0.78	0.000096	0.000096
17	34	1	0.000862	24,918,000	0.91	0.000784	0.000784
17	34	1	0.00430	24,918,000	0.51	0.00219	0.00219
17	34	1	0.000980	24,918,000	0.80	0.000784	0.000784
17	34	1	4.31	24,918,000	0.17	0.732	0.732
17	34	1	73.6	24,918,000	0.36	26.5	26.5
19	35	4	34.1	22,516,000	0.34	11.6	11.6
20 (a)	36	1	0.0408	220	0.36	0.00	0.00

TABLE 13. SUMMARY OF WASTEWATER STREAMS (CONTINUED)

Plant	Process	Number of streams per process	HAP load, Mg/yr	Flow rate, gal/yr	Fe	HAP emissions, Mg/yr	
						Uncontrolled	Controlled
21	37	13	474	47,808,000	0.17	80.5	80.5
21	37	5	17.6	47,808,000	0.80	14.1	14.1
21	38	3	87.7	5,930,100	0.17	14.9	14.9
21	38	4	3.52	5,930,100	0.80	2.81	2.81
22	39	1	0.0318	222,070	0.80	0.0254	0.0254
22	40	1	0.658	777,600	0.80	0.527	0.527
22	41	1	0.627	705,600	0.80	0.502	0.502
22	42	1	140	3,513,600	0.17	23.8	23.8
22	42	1	2.81	3,513,600	0.80	2.24	2.24
22	43	1	0.691	885,600	0.80	0.553	0.553
22	43	1	0.691	885,600	0.80	0.553	0.553
22	43	1	34.5	885,600	0.17	5.87	5.87
22	44	1	29.4	695,670	0.17	5.00	5.00
22	44	1	4.61	695,670	0.80	3.69	3.69
22	45	1	0.395	933,120	0.80	0.316	0.316

(a) Wastewater streams are disposed of by deepwell injection; there are no HAP emissions from these streams.

TABLE 14. LIST OF PARTICULATE MATTER HAP COMPOUNDS FROM BAG DUMPS AND PRODUCT DRYERS[a]

HAP	No. of plants	Emission point	Uncontrolled emissions, Mg/yr	Controlled emissions, Mg/yr	Percent reduction, %
Captan	1	product dryer	844	8.44	99
Maleic anhydride	1	bag dumps	1.66	0.00181	99.9
TOTAL			846	8.45	99

[a]HAP emitted from 2 of the 20 plants.

VI. References

1. Memorandum from K. Schmidtke, MRI, to L. Banker, EPA/ESD. November 11, 1996. Documentation of Data Base Containing Information from Section 114 Responses and Site Visits for the Production of Pesticide Active Ingredients NESHAP.

2. Memorandum from D. Randall and K. Schmidtke, MRI, to L. Banker, EPA/ESD. December 16, 1996. Recommended Control Levels for the Process Vent, Storage Tank, and Wastewater Planks of the New Source MACT Floor--Production of Pesticide Active Ingredient NESHAP.

3. 40 CFR Part 63, subpart H, section 63.161.

4. Memorandum from D. Randall, K. Schmidtke, and C. Hale, MRI, to L. Banker, EPA/ESD. April 30, 1997. Baseline Emissions for the Pesticide Active Ingredient Production Industry.

5. Memorandum from K. Schmidtke, MRI, to L. Banker, EPA:ESD. April 30, 1997. Storage Tank Data and Results of Storage Tank Emission Calculations Using TANKS3 Software--Pesticide Active Ingredient Production Industry.

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Subject: MACT Floor and Regulatory Alternatives for the Pesticide Active Ingredient Production Industry
EPA Contract 68D60012; Task Order No. 0004
ESD Project No. 93/59; MRI Project No. 4800-04

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I. Introduction

The purpose of this memorandum is to present the maximum achievable control technology (MACT) floor and regulatory alternatives for existing and new sources in the pesticide active ingredient (PAI) production industry. The Clean Air Act Amendments of 1990 (CAA) require that standards for sources of hazardous air pollutant (HAP) emissions reflect the maximum degree of reduction in HAP emissions that is achievable. This control level is referred to as MACT. The CAA also provides requirements for determining the least stringent level allowed for a MACT standard; this level is termed the "MACT floor." In addition, the CAA requires examination of alternatives more stringent than the floor. However, the CAA specifies that evaluation of regulatory alternatives that are more stringent than the floor consider the cost of achieving the emission reduction, any nonair quality health and environmental impacts, and energy requirements.

The MACT floors and regulatory alternatives for the PAI source category have been developed to reduce HAP from five types of emission points including: process vents, equipment leaks, storage vessels, wastewater systems, and bag dumps and product dryers. Each type of emission point constitutes a "plank" in the MACT floor for the source category.

The remainder of this memorandum is divided into three sections. Section II describes the approach used to determine the MACT floor and regulatory alternatives for existing sources. Section III describes the MACT floor and regulatory alternatives for new sources. Section IV lists the references.

II. Existing Source MACT Floor and Regulatory Alternatives

A. Overview for Existing Sources

1. Clean Air Act Requirements for Existing Sources. Section 112(d)(3) of the CAA specifies that standards for existing sources shall be no less stringent than "the average emission limitation achieved by the best performing 12 percent of the existing sources" for source categories and subcategories with 30 or more sources, or "the average emission limitation achieved by the best performing 5 sources" for source categories or subcategories with fewer than 30 sources.

The EPA has evaluated two interpretations of the MACT floor for existing sources. Under the first interpretation, EPA would look at the average emission limits achieved by each of the best performing 12 percent of existing sources, and the lowest would be used to represent the MACT floor. The second interpretation is that the MACT floor is represented by the "average emission limitation achieved" by the best performing sources, where the "average" is based on a measure of the central tendency, such as the arithmetic mean, median, or mode. This latter interpretation is referred to as the "higher floor interpretation." In a June 6, 1994, Federal Register notice (59 FR 29196), the EPA presented its interpretation of the statutory language concerning the MACT floor for existing sources. Based on a review of the statute, legislative history, and public comments, the EPA believes that the "higher floor interpretation" is a better reading of the statutory language. In this memorandum, the determination of the MACT floor for existing sources follows the "higher floor interpretation."

2. Determination of the Best Performing Facilities for Existing Source MACT. Because there are an estimated 78 affected facilities nationwide in the PAI source category, the MACT floor is based on the best performing 12 percent of facilities.[1] With an estimated 78 affected facilities, the best performing 12 percent consists of nine facilities.

Identification of the best performing 12 percent was accomplished by conducting a screening telephone survey followed by sending a detailed written information request to selected companies.[2] The screening telephone survey was conducted to identify several facilities that achieve high emissions reductions. The survey was also designed to identify plants that each produce a variety of PAI's, use a variety of production processes, and are major sources. Companies with multiple plants that met the criteria were favored over those with only one plant. A detailed information request was then sent to nine companies, and these companies provided data for a total of 20 plants.[3] Because plants with good emission controls were targeted to receive the information request, EPA believes that

the surveyed plants include the nine plants that are the best performing 12 percent.

The best-performing nine plants were determined based on the total percentage reduction in HAP emissions from the affected source for each of the 20 surveyed facilities. For the PAI production source category, the affected source is the collection of all process equipment and waste management units involved in the production of PAI's at the plant. Emission points from this process equipment and waste management units include process vents, equipment leaks, storage tanks, wastewater, and bag dumps and product dryers. The HAP emitted from these five planks include unchlorinated and chlorinated organic HAP, hydrochloric acid (HCl) and chlorine, and particulate matter (PM) HAP. The 20 plants are ranked in Table 1 according to their total percentage reduction in these HAP emissions.[2]

Table 1 shows plant 16 has an overall control efficiency of 99.9 percent. The only HAP emissions from this plant consist of PM HAP generated from a raw material bag dump. This is not considered to be typical of sources in this source category. As a result, this plant was not included among the best performing 12 percent of sources. The best-performing nine facilities include Plants 9, 22, 7, 17, 6, 12, 11, 20, and 8 (listed in descending order of plantwide emission reduction achieved).

3. Approach for the MACT Floors and Regulatory Alternatives for Existing Sources. After the nine best-performing sources in the source category were identified, the "average emission limitation achieved" was determined for each of the five planks at these plants. The average emission limitation was determined using the second interpretation, or the higher floor determination, discussed in section II.A.1 above. The arithmetic mean was evaluated first. When the arithmetic mean was at a level that corresponded with the control achieved by a known technology, it was selected as the MACT floor. When the arithmetic mean did not correspond with the control achieved by a known technology, the median was selected as the MACT floor.

The next step was to determine regulatory alternatives more stringent than the MACT floor. Potential regulatory alternatives were developed based on the Hazardous Organic NESHAP (HON) and the Alternative Control Techniques Document for Control of Volatile Organic Compound Emissions from Batch Processes (Batch Processes ACT).[4,5] The HON was selected because (1) the characteristics of the emissions from storage tanks, equipment leaks, and wastewater systems in the PAI production industry are similar or identical to those addressed by the HON and (2) the levels of control required under the HON were already determined through extensive analyses to be reasonable from a cost and impact perspective.

TABLE 1. OVERALL CONTROL EFFICIENCY OF HAP EMISSIONS FROM PAI PLANTS[2]

Plant	Uncontrolled HAP emissions, Mg/yr				Controlled HAP emissions, Mg/yr				Overall control efficiency, %
	Process vents[a]	Equipment leaks	Storage tanks	Wastewater	Process vents[a]	Equipment leaks	Storage tanks	Wastewater	
16[b]	1.66	0	0	0	0.002	0	0	0	99.9
9	549	14.2	0	0.03	0.540	10.7	0	0.03	98.0
7	890	57.7	0.06	0.835	21.9	57.7	0	0.835	91.5
22	5,720	136	0.64	43.1	343	136	0.01	43.1	91.2
6	16.5	0.56	0	0	1.65	0.56	0	0	87.0
17	224	128	0	29.4	8.30	12.6	0	29.4	86.8
12	388	80.4	1.83	1.26	10.8	80.4	1.12	1.26	80.2
11	394	242	6.93	931	95.1	242	1.87	9.31	77.9
20	82.1	22.7	0.47	0.0147	1.04	22.7	0.47	0[c]	77.0
8	253	69.0	0.97	42.5	17.8	69.0	0.94	0[c]	76.0
15	2.87	107	0.08	9.35	2.84	25.1	0.08	9.35	68.7
10	32.7	90.6	3.14	0.173	23.3	21.6	0.006	0.0117	64.6
23	282	126	1.74	d	31.8	126	1.74	d	61.1
19	34.3	11.3	0	11.6	0.17	11.3	0	11.6	59.7
1	171	56.8	33.1	6.17	100	39.5	1.66	6.17	44.8
21	178	79.4	4.36	112	71.4	79.4	0.73	112	29.5
3	61.9	137	0.09	1.84	2.96	137	0.01	1.84	29.4
13	18.9	22.7	0.27	25.1	0.67	22.7	0.27	24.7	27.8
14	9.96	56.7	1.16	10.9	0.20	56.7	0.02	10.9	13.9
5	52.8	48.1	2.0	2.17	51.9	47.8	0.04	2.17	3.0

[a]Particulate matter HAP emissions from bag dumps and product dryers are included in this category.
[b]This plant is not considered to be typical of the industry and, thus, is not included in the best performing 12 percent.
[c]This plant disposes of wastewater using deepwell injection.
[d]No data provided.

The Batch Processes ACT document was selected to identify regulatory alternatives for batch process vents; batch processes are not addressed by the HON. The Batch Processes ACT document covers VOC emissions, and most of the HAP emitted from PAI production facilities are also VOC. Unlike the HON, the Batch Processes ACT document is not a regulation and, therefore, does not specify a level of control that must be met. Instead, the Batch Processes ACT document provides information on potential levels of control and their costs. Using procedures in the Batch Processes ACT document, the EPA developed a regulatory alternative that requires 98 percent reduction of gaseous organic HAP emissions from "large" process vents. This level of control was selected because it was determined to be achievable, considering costs and other impacts, for process vents that meet certain flow and HAP load characteristics.

Under the CAA, EPA can distinguish among classes, types, and sizes of sources within a source category in establishing standards; one way to make distinctions is to establish applicability cutoffs. The PAI source category is comprised of many different production processes. Variability in the characteristics of these processes may affect the emission rates. To address this variability, a MACT floor and regulatory alternatives were developed that consist of applicability cutoffs as well as control efficiencies for the emission points that exceed the cutoffs. In this analysis, the cutoffs were based on uncontrolled emission rates.

B. MACT Floor and Regulatory Alternatives for Existing Sources

1. Process Vents. The MACT floor for process vents could be determined on a plant basis or on a process basis. In this analysis, the MACT floor was determined on a process basis to maintain consistency with the Batch Processes ACT document. In addition, because many processes have a dedicated control (or controls), application on a process basis would be easier to implement, monitor, and demonstrate compliance. A process-based MACT floor would also be consistent with the pollution prevention option.[6]

The MACT floor for process vents was developed from data on all 41 processes at the nine MACT floor plants. Uncontrolled and controlled emissions and the corresponding control efficiencies for each process are shown in Table 2. The HAP emissions were grouped into two categories for analysis: (1) organic HAP and (2) HCl and chlorine. The HCl emissions include both HCl from the process and HCl that was generated by burning chlorinated organic HAP in combustion-based control devices; HCl from the process was reported by the plants in responses to the information requests, and HCl generated by combustion in control devices was estimated assuming all of the chlorine in the chlorinated organics that are burned is converted to HCl.[7]

TABLE 2. SUMMARY OF PROCESS VENT EMISSIONS[a,2]

Plant No.	Process No.	Uncontrolled emissions, Mg/yr		Controlled emissions, Mg/yr		Control efficiencies, %	
		Organics	HCl[b]	Organics	HCl[b]	Organics	HCl
6	16	16.5	0	1.65	0	90.0	
7	17	33.0	0	0.660	0	98.0	
7	18	12.8	0	12.8	0	0.0	
8	19	202	13.2	13.0	1.32	93.6	90.0
8	20	15.3	6.80	1.53	0.680	90.0	90.0
8	22	1.41	[c]	0.141	[c]	90.0	
8	23	0	14.5	0	1.21		91.7
9	24	0	356	0	0.356		99.9
9	25	18.2	191	0.364	0.191	98.0	99.9
11	28	16.1	0	5.33	0	66.9	
11	29	59.5	0	19.7	0	66.9	
11	30	48.3	0	16.0	0	66.9	
11	31	92.2	19.8	40.0	0.198	56.6	99.0
11	32	110	77.0	8.92	0.770	91.9	99.0
11	33	64.7	45.3	5.24	0.453	91.9	99.0
11	34	0.354	0	0.0071	0	98.0	
11	35	0.154	0	0.0031	0	98.0	
11	36	0.399	0	0.0080	0	98.0	
12	37	4.59	11.0	0.0918	0.110	98.0	99.0
12	38	24.3	0.000	0.504	0.000	97.9	0.0
12	39	199	212	5.93	2.48	97.0	98.8
12	40	48.2	50.4	3.11	0.304	93.5	99.4
17	60	0.337	0.29	0.0067	0.29	98.0	0.0
17	61	8.19	0	0.164	0	98.0	
17	62	15.3	0	2.91	0	81.0	
17	63	200	0	5.22	0	97.4	
20	65	0.146	0	0.146	0	0.0	
20	66	81.8	0	0.807	0	99.0	
22	74	347	2,393	6.94	57.8	98.0	97.6
22	75	53.1	355	1.06	8.75	98.0	97.5
22	76	4.54	0	0.0907	0	98.0	
22	77	4.54	0	0.0907	0	98.0	
22	78	23.8	0	0.475	0	98.0	
22	79	8.30	55.3	0.166	1.38	98.0	97.5
22	80	1.81	0	0.0363	0	98.0	
22	81	1.38	0	0.0276	0	98.0	
22	82	57.5	1.67	1.15	1.67	98.0	0.0
22	83	28.9	0.84	0.579	0.84	98.0	0.0
22	84	96.3	0.101	1.93	0.101	98.0	0.0
22	85	66.7	0	1.33	0	98.0	
22	86	1,730	598	34.5	331	98.0	44.7

[a]Includes all processes at the nine MACT floor plants. Some of the controlled emissions and control efficiencies were changed for reasons that are described in the Recommended Control Levels for New Source MACT Floor memorandum.[8]

[b]The HCl emissions include HCl and chlorine from the process and HCl created by burning chlorinated organics in a combustion-based control device, assuming all of the chlorine in the chlorinated organic is converted to HCl.[7]

[c]No data provided.

Thirty-nine of the processes had organic HAP emissions and 20 had HCl and chlorine emissions. Additional details about the data are presented in the Data Summary memorandum.[2]

In responses to the information request, several facilities reported control efficiencies for thermal oxidation control devices of 99 percent or more. These reported control efficiencies were based on the results of trial burns for compliance with RCRA regulations or were based on the results of emissions tests when burning either liquid waste alone or both liquid waste and process vent emissions.[8] No data are available on the control level when burning only process vent emissions. However, based on numerous incinerator emission tests, it is reasonable to assume that the control level is at least 98 percent.[9] Therefore, reported control levels above 98 percent were changed to 98 percent for use in the MACT floor analysis.

As noted above, the MACT floor consists of both an applicability cutoff and a control efficiency requirement for processes that exceed the cutoff. Separate cutoffs were determined for each of the three categories of HAP emissions from process vents. These cutoffs were determined by first ranking the processes by uncontrolled emission rates in each category and then examining the list for an appropriate cutoff. The 39 processes at the nine MACT floor plants with organic HAP emissions are listed in Table 3. For the organic HAP emissions, process 65 had the lowest uncontrolled emissions, and this process was uncontrolled. Process 35 had the second lowest uncontrolled emissions (0.154 Mg/yr), and it was controlled. A cutoff of 0.15 Mg/yr (330 lb/yr) was selected because this is the highest point below which the arithmetic mean control efficiency is no control; for higher cutoffs, the arithmetic mean control efficiency for processes below the cutoff would be at least 49 percent. For the 38 processes with uncontrolled emissions above the 0.15 Mg/yr (330 lb/yr) cutoff, the arithmetic mean control efficiency was 90 percent. Because this efficiency can be achieved by various control devices, it was selected as the MACT floor control level. Therefore, the MACT floor for organic HAP emissions from process vents consists of a control efficiency of 90 percent for processes with uncontrolled emissions greater than or equal to 0.15 Mg/yr (330 lb/yr).

All 20 processes at the MACT floor plants with HCl and chlorine emissions are ranked in Table 4 according to uncontrolled emissions. Processes 38, 60, 82, 83, and 84 have the lowest uncontrolled HCl and chlorine emissions, and each is uncontrolled. All of the other 15 processes with HCl and chlorine emissions are controlled. A cutoff was established at uncontrolled emissions of 6.80 Mg/yr (7.5 tons/yr), which is equal to the lowest uncontrolled emissions from a controlled process (process 20). This value was selected because it is the highest value below which the arithmetic mean control efficiency is no control; for higher cutoffs, the arithmetic mean control

TABLE 3. SUMMARY OF ORGANIC EMISSIONS FROM PROCESS VENTS[a]

Plant No.	Process No.	Uncontrolled emissions, Mg/yr	Controlled emissions, Mg/yr	Control efficiencies, %
22	86	1,730	34.5	98.0
22	74	347	6.94	98.0
8	19	202	13.0	93.6
17	63	200	5.22	97.4
12	39	199	5.93	97.0
11	32	110	8.92	91.9
22	84	96.3	1.93	98.0
11	31	92.2	40.0	56.6
20	66	81.8	0.807	99.0
22	85	66.7	1.33	98.0
11	33	64.7	5.24	91.9
11	29	59.5	19.7	66.9
22	82	57.5	1.15	98.0
22	75	53.1	1.06	98.0
11	30	48.3	16.0	66.9
12	40	48.2	3.11	93.5
7	17	33.0	0.660	98.0
22	83	28.9	0.579	98.0
12	38	24.3	0.504	97.9
22	78	23.8	0.475	98.0
9	25	18.2	0.364	98.0
6	16	16.5	1.65	90.0
11	28	16.1	5.33	66.9
8	20	15.3	1.53	90.0
17	62	15.3	2.91	81.0
7	18	12.8	12.8	0.0
22	79	8.30	0.166	98.0
17	61	8.19	0.164	98.0
12	37	4.59	0.0918	98.0
22	76	4.54	0.0907	98.0
22	77	4.54	0.0907	98.0
22	80	1.81	0.0363	98.8
8	22	1.41	0.141	90.0
22	81	1.38	0.0276	98.0
11	36	0.399	0.0080	98.0
11	34	0.354	0.0071	98.0
17	60	0.337	0.0067	98.0
11	35	0.154	0.0031	98.0
20	65	0.146	0.146	0.0
Average[b]				90.2

[a]Includes all processes at the nine MACT floor plants with organic HAP emissions. Some of the controlled emissions and control efficiencies were changed for reasons that are described in the Recommended Control Levels for New Source MACT Floor memorandum.[8]

[b]The average control efficiency for organic HAP emissions is based on the efficiencies for the 38 processes with uncontrolled organic HAP emissions greater than 0.15 Mg/yr.

TABLE 4. SUMMARY OF HCl AND CHLORINE EMISSIONS FROM PROCESS VENTS[a,b]

Plant No.	Process No.	Uncontrolled emissions, Mg/yr	Controlled emissions, Mg/yr	Control efficiencies, %
22	74	2,390	57.8	97.6
22	86	598	331	44.7
9	24	356	0.356	99.9
22	75	355	8.75	97.5
12	39	212	2.48	99.8
9	25	191	0.191	99.9
11	32	77.0	0.770	99.0
22	79	55.3	1.38	97.5
12	40	50.4	0.304	99.4
11	33	45.3	0.453	99.0
11	31	19.8	0.198	99.0
8	23	14.5	1.21	91.7
8	19	13.2	1.32	90.0
12	37	11.0	0.110	99.0
8	20	6.80	0.680	90.0
22	82	1.67	1.67	0.0
22	83	0.84	0.84	0.0
17	60	0.29	0.29	0.0
22	84	0.101	0.101	0.0
12	38	0.000	0.000	0.0
Average[c]				93.5

[a]Includes all processes at the nine MACT floor plants with HCl emissions. Some of the controlled emissions and control efficiencies were changed for reasons that are described in the Recommended Control Levels for New Source MACT Floor memorandum.[8]

[b]The HCl emissions include HCl and chlorine from the process and HCl created by burning chlorinated organics in a combustion-based control device, assuming all of the chlorine in the chlorinated organic is converted to HCl.[7]

[c]The average HCl control efficiency is based on the efficiencies for the 15 processes with uncontrolled HCl emissions greater than 6.80 Mg/yr.

efficiency for processes below the cutoff would be at least 18 percent. Above the 6.80 Mg/yr (7.5 tons/yr) cutoff, the arithmetic mean control efficiency is 94 percent. Because this level can be achieved by control technologies, it was selected as the MACT floor control level. Therefore, the MACT floor for HCl and chlorine emissions from process vents consists of a control efficiency of 94 percent for processes with uncontrolled emissions greater than or equal to 6.80 Mg/yr (7.5 tons/yr).

Two regulatory alternatives beyond (i.e., more stringent than) the floor were developed. Regulatory Alternative 1 would require 98 percent control of organic HAP emissions from vents that meet certain flow and uncontrolled HAP mass loading criteria and that currently are not controlled to the MACT floor level of 90 percent. For all other process vents, Regulatory Alternative 1 would be equivalent to the MACT floor. Specifically, a 90 percent reduction in organic HAP emissions would be required from the combination of all vents within a process, excluding vents that meet the requirements for 98 percent control. In additon, a 94 percent reduction in combined HCl and chlorine emissions would be required from the combination of all vents within a process. Regulatory Alternative 2 would require 98 percent control of organic HAP and 99 percent control of combined HCl and chlorine emissions on a process basis. The applicability cutoffs for the MACT floor would apply under both regulatory alternatives (i.e., process-based uncontrolled emissions ≥0.15 Mg/yr (330 lb/yr) for organic HAP emissions and ≥6.8 Mg/yr (7.5 tons/yr) for combined HCl and chlorine emissions).

A process vent would meet the criteria for 98 percent control of organic HAP emissions under Regulatory Alternative 1 if (1) the current annual organic HAP control is less than 90 percent and (2) the actual total flow rate from the vent is less than the flow rate calculated using the following equation:

$$FR = 0.02 * HL - 1{,}000$$

where:

FR = calculated flowrate, scfm
HL = actual HAP emission load from the vent, lb/yr

This equation was developed using a method nearly identical to the approach described in the Batch Processes ACT.[4] Using this method, a series of curves was developed that approximates boundaries of cost effective control for a range of emission stream characteristics (i.e., flow rate and operating hours) and types of control devices (i.e., thermal incinerators and condensers) for a given annual HAP load. Similar series of curves were generated for several additional annual HAP loads. From each series of graphs, the average flow rate corresponding to an optimum cost effectiveness of $3,500/Mg was determined. These flow rates were then plotted versus the corresponding annual HAP load, and a simple linear regression analysis was used

to define a line through the points; this line represents the limits of cost effective control to 98 percent. The cost effectiveness target of $3,500/Mg was selected based on decisions in previously promulgated part 63 rules where this value was judged to be reasonable.

The difference between the method used in this analysis and that in the Batch Processes ACT involved the number of pollutants that were evaluated. In the analysis for Regulatory Alternative 1, the annual HAP load was represented only with methanol, whereas the Batch Processes ACT used several pollutants, each with different volatilities. Methanol was used in this analysis because it is one of the most common HAP in process vent emissions at PAI manufacturing plants; it also has a moderate volatility, which means the resulting cost effectiveness should represent the average cost effectiveness for the range of actual HAP emissions. Additional details about the methodology and the resulting curves for this analysis are provided in a separate memorandum.[10]

2. Storage Tanks. Storage tank emissions are a function of many factors, including the size of the tank, the vapor pressure, throughputs, and molecular weight of the stored material. Therefore, the methodology used to develop the storage tank plank of the MACT floor focused on the characteristics of individual tanks at the MACT floor plants rather than the plant wide control efficiency for storage tanks at these plants. The characteristics for tanks at the MACT floor facilities are shown in Table 5.

The MACT floor for storage tanks is based on 42 tanks at the nine MACT floor plants. The MACT floor for storage tanks consists of two applicability cutoffs and a control efficiency requirement for tanks that exceed the cutoffs. To determine the cutoff, the tanks were first ranked according to their uncontrolled emissions, as shown in Table 5. The list in Table 5 shows a majority of the tanks with low uncontrolled emissions were not controlled. Working up from the bottom of the list, the median control efficiency is 0 percent for all tanks with uncontrolled emissions below any cutoff up to 0.11 Mg/yr (240 lb/yr). Above a cutoff of 0.11 Mg/yr (240 lb/yr) the median control efficiency is 41 percent. Thus the first cutoff was determined to be uncontrolled emissions ≥0.11 Mg/yr (240 lb/yr).

A second cutoff was established based on the capacity of the tank. In the group of tanks with uncontrolled emissions ≥0.11 Mg/yr (240 lb/yr), the smallest tank had a capacity of 6,540 gal. The two next smallest tanks have capacities of about 10,000 gal, and both are controlled to 98 percent. A capacity cutoff of 38 m^3 (10,000 gal) was selected because this is the smallest tank in the group of tanks with uncontrolled emissions ≥0.11 Mg/yr (240 lb/yr) that is controlled to the median control efficiency of 41 percent. Therefore, the MACT floor for storage

TABLE 5. STORAGE TANK CHARACTERISTICS AT MACT FLOOR PLANTS[2]

Tank number	Plant number	HAP	Tank size, gal	Uncontrolled emissions, kg/yr	Control level, %[a]	Controlled emissions, kg/yr
1	11	ETHYLENE DICHLORIDE	144,000	3,220	98	64.5
2	11	ETHYLENE DICHLORIDE	27,000	1,360	98	27.3
3	11	XYLENE	1,567,000	1,090	25	816
4	12	TRICHLOROETHYLENE	20,000	752	0	752
5	8	METHANOL	100,000	692	0	692
6	11	METHYLENE CHLORIDE	6,540	554	4	532
7	22	METHANOL	102,000	525	98	10.5
8	12	HEXANE	20,000	348	0	348
9	11	METHANOL	13,500	260	42	151
10	11	TOLUENE	12,690	231	13.2	201
11	20	DIMETHYL HYDRAZINE	14,000	192	0	192
12	20	DIMETHYL HYDRAZINE	12,000	164	0	164
13	12	TOLUENE	40,000	127	98	2.52
14	12	TOLUENE	10,300	124	98	2.48
15	11	TOLUENE	13,500	118	41	69.5
16	12	TOLUENE	32,000	116	98	2.32
17	22	TOLUENE	31,600	112	98	2.24
18	12	MIX-TOLUENE/CYANOHYDRIN	84,000	108	98	2.15
19	8	TRICHLOROBENZENE	220,000	98.2	0	98.2
20	12	METHANOL	10,500	76.8	98	1.54
21	8	TRICHLOROBENZENE	500,000	67.3	0	67.3
22	12	MIX-TOLUENE/METHYLENE CHLORIDE	10,300	65.6	98	1.31
23	12	TOLUENE	10,300	63.9	98	1.28
24	20	ACETONITRILE	12,378	62.2	0	62.2
25	7	MALEIC ANHYDRIDE	14,500	55.5	99.5	0.28
26	8	XYLENE	27,000	49.7	0	49.7
27	11	METHYL ISOBUTYL KETONE	7,900	45.6	89	5.02
28	11	TOLUENE	30,000	43.8	98	0.88
29	12	MIX-HEXANE/TRICHLOROBENZENE	7,500	32.8	98	0.66
30	8	TOLUENE	10,000	34.4	90	3.44
31	8	METHANOL	35,000	32.2	0	32.2
32	20	HYDRAZINE HYDRATE	30,000	30.0	0	30.0
33	12	MIX-ETHYL BENZENE/XYLENE	40,000	16.0	98	0.33
34	20	HYDRAZINE HYDRATE	25,600	12.7	0	12.7
35	20	MALEIC ANHYDRIDE	16,000	12.4	0	12.4
36	11	MIX-FORMALDEHYDE/METHANOL	30,600	7.05	98	0.14
37	12	TRICHLOROBENZENE	30,000	3.40	0	3.40
38	12	FORMALDEHYDE	7,000	0.38	98	0.01
39	8	ETHYLENE GLYCOL	7,000	0.08	0	0.08
40	8	ETHYLENE GLYCOL	7,000	0.04	0	0.04
41	8	ETHYLENE GLYCOL	7,000	0.04	0	0.04
42	17	ETHYLENE GLYCOL	17,760	0.01	0	0.01

[a]Plants reported control efficiencies of 99.99 percent for several tanks that are controlled with thermal oxidizers and other combustion-based control devices. These values were changed to 98 percent for reasons that are described in a memorandum in the Recommended Control Level for New Source MACT Floor memorandum.[8]

tanks was determined to be 41 percent control for storage tanks with uncontrolled emissions ≥0.11 Mg/yr (240 lb/yr) and capacities ≥38 m^3 (10,000 gal).

One regulatory alternative more stringent than the MACT floor was also developed for storage tanks. This alternative would require 95 percent control of storage tanks with capacities greater than or equal to 76 m^3 (20,000 gal) that have uncontrolled emissions that are greater than or equal to 0.11 Mg/yr (240 lb/yr); tanks with smaller capacities that meet the uncontrolled emissions cutoff for the MACT floor would be required to control to the level of the MACT floor. Floating roof technology has been demonstrated to achieve 95 percent control and is considerably less expensive than other technologies, even technologies that achieve control levels of less than 95 percent; therefore, it is the preferred method of control for tanks with capacities of greater than 76 m^3 (20,000 gal). Regulatory alternative 1 takes advantage of this fact for tanks that can be equipped with floating roof technology and merely requires the level of control that has been demonstrated to be cost effective and technically feasible to achieve. Regulatory alternative 1 also requires no additional control of any tank that is currently equipped with a control device achieving at least 41 percent control. This provision was included in the regulatory alternative because the cost associated with the incremental reduction achieved by increasing control from 41 percent to 95 percent is not reasonable.[11]

3. Equipment leaks. The MACT floor for equipment leaks was determined to be no control. This determination was based on all equipment leak data provided by the nine MACT floor plants and on the modelled equipment counts for those plants that did not provide data.[2,12] The arithmetic mean of control efficiencies in Table 6 is 13 percent, and the median is 0 percent. The arithmetic mean does not represent the performance of any known regulatory program for equipment leaks. Therefore, the median (i.e., no control) was determined to be the MACT floor.

One regulatory alternative more stringent than the floor was developed. This alternative is the implementation of all of the requirements in subpart H of 40 CFR part 63, except that it does not cover receivers and surge control vessels. Receivers and surge control vessels are process vessels that typically operate in batch mode. They also have vents like other types of process vessels. Therefore, it is more appropriate to regulate emissions from these vessels as process vent emissions rather than equipment leak emissions.

4. Wastewater. The MACT floor for wastewater systems was determined to be no control of HAP evaporative losses from wastewater collection and treatment systems. The MACT floor determination for wastewater is based on all wastewater data

TABLE 6. CONTROL EFFICIENCIES FOR EQUIPMENT LEAKS AT MACT FLOOR PLANTS[2]

Plant	Control efficiency, percent
6	0.0
7	0.0
8	0.0
9	24.6
11	0.0
12	0.0
17	90.0
20	0.0
22	0.0

TABLE 7. CONTROL EFFICIENCIES FOR WASTEWATER SYSTEMS AT MACT FLOOR PLANTS[2]

Plant	Control efficiency, percent
6	0.0
7	0.0
8	a
9	0.0
11	99.0[b]
12	0.0
17	0.0
20	a
22	0.0

[a]This plant disposes of wastewater using deepwell injection.
[b]Control based on incineration of all wastewater.

provided by the nine MACT floor plants.[2] The plantwide emissions reduction for wastewater was determined at each plant. Table 7 presents the plantwide wastewater control efficiencies being achieved at the MACT floor plants. Only one of these plants treats wastewater with a technology that controls emissions. Based on the data in Table 7, the arithmetic mean and median of the wastewater system control efficiencies for the MACT floor plants are 14 and 0 percent, respectively. The arithmetic mean excludes plants 8 and 20, which use deep-well injection to dispose of wastewater. Because this disposal method is not available to all sources, it was not included in the MACT floor analysis. It is, however, a technology that can be used to meet the proposed control requirements. Because the arithmetic mean efficiency does not correspond with the control efficiency of any control technology, the median (i.e., no control) was determined to be the MACT floor.

One regulatory alternative more stringent than the floor was developed for wastewater. This alternative would be to implement the requirements in the HON (i.e., §§ 63.131 through 63.149 of subpart G of part 63). This alternative specifies certain design and emission control requirements for waste management units and a variety of control options for wastewater treatment units.

For this alternative, Group 1 wastewater streams containing Table 9 HAP compounds would be controlled. Table 9 is in 40 CFR part 63, subpart G. A Group 1 stream is defined as those streams with the total annual average concentration of Table 9 compounds: (1) that is greater than or equal to 10,000 ppmw at any flow rate, or (2) that is greater than or equal to 1,000 ppmw and the annual average flow rate is greater than or equal to 10 L/min (2.6 gal/min). The regulatory alternative would require Group 1 wastewater streams for Table 9 compounds to do one of the following: (1) reduce the concentration of Table 9 compounds to less than 50 ppmw; (2) use a steam stripper with specific design and operating requirements; (3) reduce the mass flow rate of Table 9 compounds by at least 99 percent; (4) reduce the mass flow rate of Table 9 compounds by an amount equal to or greater than the Fr value in Table 9; (5) for a source using biotreatment for at least one wastewater stream that is Group 1 for Table 9 compounds, to achieve a required mass removal greater than or equal to 95 percent for Table 9 compounds; or (6) treat wastewater streams with permitted RCRA units or by discharging to a permitted underground injection well.[5]

Unlike the HON, this regulatory alternative applies to maintenance wastewater as well as process wastewater. Maintenance wastewater was excluded under the HON because it is generated in batches, whereas the process wastewater is generated continuously. However, in the PAI production industry, batch processes with batch discharges are common. Thus, the same procedures used to determine process streams that are subject to

control would be used to determine maintenance streams that are subject to control.

5. Bag dumps and product dryers. Only one of the MACT floor plants emits PM HAP from bag dumps or product dryers. The PM HAP emissions at this plant are from a product dryer that is controlled with a fabric filter. This fabric filter controls PM HAP emissions to a concentration below 22.9 milligrams per dry standard cubic meter (mg/dscm) (0.01 grains per dry standard cubic foot [gr/dscf]). This level is typical for fabric filter controls and, thus, was selected as the MACT floor for PM HAP emissions from bag dumps and product dryers. No alternative more stringent than the MACT floor was developed because the MACT floor was based on the best control at an existing plant, and the level represents good control.

III. New Source MACT Floor and Regulatory Alternatives

A. Overview

1. Clean Air Act Requirements for New Sources. Section 112(d)(3) of the CAA specifies that standards for new sources in a source category or subcategory "shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source, as determined by the Administrator."

2. Approach for the MACT Floors and Regulatory Alternatives for New Sources. The MACT floor for new sources in the PAI production industry represents a high level of control that is at the limit of technical feasibility for four of the five planks. Therefore, no options above the floor were developed for process vents, storage tanks, equipment leaks, or bag dumps and product dryers. Alternatives more stringent than the MACT floor were developed only for wastewater systems. The remainder of this section describes the five planks of the new source MACT floor and the regulatory alternatives for wastewater.

B. MACT Floor and Regulatory Alternatives for New Sources

1. Process vents. The MACT floor for process vents at new sources was determined on a process basis using data for the best controlled processes at the best performing plants. Data for the best performing plants are shown in Table 2. The MACT floor for new sources also consists of applicability cutoffs and control efficiency requirements for the same two categories of HAP emissions described above for existing sources: (1) organic HAP and (2) HCl and chlorine.

To determine the MACT floor for organic HAP emissions, the processes in Table 2 were first ranked by their uncontrolled organic HAP emissions. Process 35 is the controlled process with

the lowest uncontrolled emissions (0.154 Mg/yr). This process is controlled to 98 percent, and this level represents the best control that is being achieved. Therefore, the MACT floor consists of 98 percent control for any process with uncontrolled organic emissions greater than or equal to 0.15 Mg/yr (330 lb/yr).

In responses to the information collection request, a facility reported scrubber control efficiencies of 99.99 percent or higher for HCl. These reported control efficiencies were based on design parameters of the scrubbers and were not based on the results of an emissions test.[8] Without specific test data to demonstrate the control efficiency actually achieved by the facility in the PAI production industry, control efficiencies demonstrated for similar control devices in another industry were evaluated. Test data for an application in another industry demonstrated scrubber control efficiencies for HCl of at least 99.9 percent.[13] Therefore, higher reported control efficiencies were changed to 99.9 percent, as shown in Table 2.

To determine the MACT floor for HCl and chlorine emissions, the processes in Table 2 were first ranked by their total uncontrolled HCl and chlorine emissions. Processes 24 and 25 are both controlled to 99.9 percent. This level represents the best control that is being achieved; therefore, the control efficiency component of the MACT floor was determined to be 99.9 percent. The other component of the floor is the applicability cutoff. To determine the cutoff, EPA examined the uncontrolled HCl and chlorine emissions from processes 24 and 25. The lowest value is the 191 Mg/yr (211 tons/yr) emissions from process 24. Therefore, 191 Mg/yr (211 tons/yr) is the cutoff associated with the 99.9 percent control level. The floor for new sources cannot be less stringent than for existing sources. Therefore, the floor consists of a 94 percent control level for processes with uncontrolled HCl and chlorine emissions greater than or equal to 6.80 Mg/yr (7.5 tons/yr) and less than 191 Mg/yr (211 tons/yr) (i.e., the MACT floor level of control for existing sources).

2. Storage Tanks. The MACT floor for storage tank emissions at new sources was based on the best performing tanks at the nine MACT floor plants. To determine the MACT floor, all of the storage tanks at the best performing plants were first ranked according to their uncontrolled emissions; the tanks are ranked in Table 5. The best level of control being achieved is 98 percent. Because the data show many tanks are controlled to 98 percent, the best performing individual tank from this group was determined based on the applicability cutoffs of uncontrolled emissions and tank capacity. In Table 5, tank 38 is the tank with the lowest uncontrolled emissions that are controlled to 98 percent; these emissions are 0.45 kg/yr (1 lb/yr). Tank 38 also has a capacity of 26 m^3 (7,000 gal), which is the smallest tank that is controlled to 98 percent. Thus, the new source MACT floor was determined to be 98 percent control for any storage

tank with uncontrolled emissions greater than or equal to 0.45 kg/yr (1 lb/yr) and a capacity greater than or equal to 26 m^3 (7,000 gal). (Tank number 25 is controlled to 99.5 percent, but it is controlled with a scrubber. A scrubber efficiency is related to the characteristics of the HAP being controlled; although it may achieve a high control level for a soluble compound, it would not achieve the same control level on other compounds.)

3. Equipment leaks. The MACT floor for equipment leaks at new sources is based on the facility with the best controlled equipment leak emissions. The MACT floor for equipment leak emissions at new sources was determined to be the LDAR requirements in subpart H of 40 CFR part 63. This floor is based on the finding that two PAI production facilities are implementing LDAR programs that are consistent with the subpart H requirements. No facility is controlling equipment leaks to a level above that achieved with the subpart H requirements.

4. Bag dumps and product dryers. The best performing PAI production source uses a fabric filter to control PM HAP emissions from process vents on a product dryer. Based on emissions test data, PM HAP emissions at this source do not exceed 22.9 mg/dscm (0.01 gr/dscf). Thus, the MACT floor for PM HAP emissions from dryer vents was determined to be 22.9 mg/dscm (0.01 gr/dscf).

5. Wastewater systems. The new source MACT floor for wastewater was determined to be 99 percent control of all wastewater streams at plants that have a total HAP mass flow rate (of Table 9 compounds in subpart G of part 63) of 2,100 Mg/yr (2,300 tons/yr) or more in wastewater from all POD's. For all other plants the floor was determined to be no control.

As shown in Table 7, one of the best performing facilities incinerates all of its wastewater, two dispose of wastewater using deepwell injection, and the others do not use treatment technology that controls emissions. A facility using deepwell injection cannot be considered a similar source because the technology is not available to all sources. Therefore, the new source MACT floor for wastewater is based on the practices of a single facility that is burning all of its wastewater in RCRA incinerators that burn a mixture of wastes. This facility is the best performer due to the degree and extent to which it is controlling wastewater streams containing HAP compounds that are listed in Table 9. Wastewater streams from nine processes are incinerated at this plant. Data for these streams are presented in the Data Summary memorandum.[2]

The control level for the best performing source was determined as follows. Based on trial burns, the plant reported in its response to the information collection request that the incinerators have control efficiencies of 99.99 percent on

hazardous waste, but no wastewater-specific control efficiency data are available. However, it is reasonable to assume, because these are RCRA incinerators, that the control efficiency is at least 99 percent, the same level achievable by steam stripping for many compounds. Data are not available to conclude that the incinerator is achieving a greater efficiency. Therefore, the MACT floor control efficiency was determined to be 99 percent.[8]

To determine the cutoff for the floor, the mass flow rate of Table 9 compounds that are being incinerated at the best performing facility was examined. Collectively, the wastewater streams at the facility contain more than 2,100 Mg/yr (2,300 tons/yr) of Table 9 compounds. Thus, 2,100 Mg/yr (2,300 tons/yr) is the applicability cutoff associated with the 99 percent control level of the MACT floor.

Two regulatory alternatives more stringent than the floor were developed. Both alternatives include the floor control requirements for sources that have a total mass flow rate of Table 9 compounds of 2,100 Mg/yr (2,300 tons/yr) or more, but requirements for other sources differ. Regulatory alternative 1 would require new sources with mass flow rate below this cutoff to implement the HON requirements for existing sources (i.e., the requirements in §§ 63.131 through 63.149 of subpart G of part 63). This alternative would require owners and operators to control Group 1 streams for Table 9 compounds. Regulatory alternative 2 would require new sources below the mass flow rate cutoff to implement the HON requirements for new sources (i.e., the same requirements as for existing sources except that Group 1 streams for Table 8 compounds also must be controlled). Regulatory alternative 2 is more stringent than regulatory alternative 1 because the applicability cutoffs for Group 1 streams are lower for Table 8 compounds than for Table 9 compounds. Both regulatory alternatives apply to maintenance wastewater streams and process wastewater streams.

The requirements for sources with mass flow rates that exceed the mass flow rate cutoff are more stringent than the HON requirements for two reasons. First, these facilities would be required to control all wastewater streams at the source, whereas the HON only requires control of Group 1 streams. Second, these facilities would be required to achieve 99 percent control for each stream, whereas the HON requires control levels at least equal to the Fr values, which, for many compounds, are less than 0.99. Additionally, as for sources that do not exceed the mass flow rate cutoff, these requirements apply to maintenance wastewater streams as well as process wastewater streams.

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